A star (*) indicates that the Abstract deals with Apparatus and Instruments.

FEBRUARY, 1935.

GENERAL PHYSICS.

ADSORPTION.

522. Two-Dimensional Equation of State and Structure of Surface Layers. B. Tamamushi. *Chem. Soc. Japan, Bull.* 9. *pp.* 363–393, *Sept., and pp.* 475–493, *Nov.*, 1934. *In German.*—The equation of state of an adsorbed layer is derived by the method of Virial, and thence the adsorption-equation, Langmuir's and Freundlich's adsorption isotherms are derived thermodynamically. The theoretical relations are compared with empirical data for the homologous series derived from the normal fatty acids. The lateral cohesion forces in the fatty acids are expressed in part electrostatically and in part by quantum mechanics, and an explanation of Traube's rule is given on this basis. The equation of state of surface layers of pure liquids is derived. Surface tension is expressed as the sum of the static cohesion, the thermal agitation, and inter-molecular forces independent of temperature. On this basis Eötvös' formula $\sigma = K (v_0 - T)$ is derived. K is a function usually different from substance to substance and dependent on temperature. Reasons for abnormal values of K are put forward. An explanation of the $\sigma - T$ curve for anisotropic liquids is given. Finally the dipole moments of *p*-azoxyanisol and *p*-azoxyphenetol are calculated. P. H. B.

523. Chemisorption on Charcoal. Influence of Ultraporosity on Adsorption. A. King. *Chem. Soc., J. pp.* 1975–1980, *Dec.*, 1934.—The effect of progressive activation of ash-free charcoals on the adsorption of molecules of different sizes has been studied. It is found that the larger molecules are only appreciably adsorbed at a comparatively late stage in the oxidation, and this is ascribed to a gradual increase in the pore size. Traube's rule is invariably obeyed if the ultrapores are sufficiently enlarged by oxidation. The density of charcoal increases regularly with time of oxidation. The pore diameter of charcoals is increased by evacuation, the activity of impure charcoals increasing greatly and that of pure charcoals less. The concept of ultraporosity is applied to the results of other workers on the area of charcoals, and reasons are put forward for the specific nature of adsorptions by certain charcoals. [See Abstracts 4767 and 4770 (1934).] AUTHOR.

See also Abstracts 777, 925, 931.

ATOMIC AND MOLECULAR STRUCTURE.

524. Nuclear Forces and Bindings. W. M. Elsasser. *Comptes Rendus,* 199. *pp.* 1406–1408, *Dec.* 10, 1934.—The model previously suggested [see Abstract 7 (1935)] is applied to questions of nuclear structure with special reference to the diplon and helion ; a more precise definition of sub-group [see Abstract 3970 (1934)] is given, and it is shown that in the heavier nuclei (heavier than Ca) a layer arrangement predominates. C. A. S.

525. Application of Pauli's Principle to Nuclei. Part III. W. M. Elsasser. *J. de Physique et le Radium,* 5. *pp.* 635–639, *Dec.*, 1934.—Aston's determination of the isotopic constitution of the rare earth elements [see Abstract 3078 (1934)] has enabled the author's views on nuclear constitution to be extended to elements of atomic number > 60. Similar relations are shown to hold, and two additional layers 7*i* and (probably) 6*g* are suggested with 83–98 and 99–116 neutrons respectively, while the layer with 117–126 N is probably an interior one with little stability. These inferences are upheld by a consideration of the α-disintegration energies of the radioactive elements, implying a discontinuity at the element with 126N + 82P (Pb); and further supported by the distribution of isotopes, which points to a change in internal structure of the nuclei at that point. [For Part II see Abstract 3970 (1934).] C. A. S.

526. Quantum Theory of the Diplon. H. Bethe and R. Peierls. *Roy. Soc., Proc.* 148*A*. *pp.* 146–156, *Jan.* 1, 1935.—It is shown that present knowledge of the intra-nuclear forces allows definite predictions to be made for the behaviour of the diplon. According to these calculations the cross-section for disintegration of a diplon by absorption of γ-rays is of the order 10^{-27} cm^2. In addition the cross-sections for capture of neutrons by protons, for scattering of γ-rays, and disintegration by electron bombardment, have been calculated. AUTHORS.

527. Interaction of Light Nuclei. Part I. H. S. W. Massey and C. B. O. Mohr. *Roy. Soc., Proc.* 148*A*. *pp.* 206–225, *Jan.* 1, 1935.—Assuming the values of the binding energies of the nuclei, ${}_1H^2$, ${}_1H^3$, and ${}_2He^3$, calculations have been carried out for (1) cross-sections and angular distributions for elastic scattering of neutrons by protons, diplons, and helium nuclei; (2) cross-sections for radiative combination of neutrons and protons, and for the reverse process, the disintegration of diplons by γ-rays; (3) cross-sections for continuous radiation by protons in collision with neutrons; (4) cross-sections for the disintegration of diplons by α-particles. Comparison with experiment is effected where possible, but a number of results are arrived at which, though capable of experimental test, have not yet been considered experimentally. Definite conclusions as to the nature of the interaction of the nuclei concerned cannot yet be arrived at until these experiments have been performed. AUTHORS.

528. Artificial Radioactivity and the Scheme of Landé. I. Kurčatov. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 202–207, *Nov.* 1, 1934. *In English.*—The investigations of Fermi, following Heisenberg's theory that the fundamental elements of nuclear structure are protons and neutrons, have led to the detection of a series of radioactive elements. From a graphical analysis of Heisenberg's theory, applied to a series of light elements up to phosphorus, it is shown that the recently detected radioactive isotopes O^{19}, Ne^{23}, Mg^{27}, Si^{31}, N^{16}, F^{20}, Na^{24}, Al^{26}, P^{32} correspond to those predicted by Fermi's scheme. Mechanisms are proposed, and it is shown that all new β-radioactive isotopes lie in the region of stable elements, but certain structural anomalies exist. These can be corrected by taking into account Landé's work on the existence of α-particles in the nucleus, from which it follows that the number of neutrons not associated with an α-particle is, for light radioactive elements, equal to 3, and for the group of elements of atomic number 17 to 29 is equal to 7. These neutrons are distributed in the form of shells having a regularity which can be explained by assuming that, in nuclei containing neutrons for which corresponding levels do not exist, these neutrons will emit an electron, thus becoming protons. N. M. B.

529. Radioactivity Induced by Neutrons. W. Yeh. *Comptes Rendus*, 199. *pp.* 1404–1406, *Dec.* 19, 1934.—When 10/log*T* is plotted

against the number of protons for the artificially produced radioactive elements from N to Sr, assuming their nuclei to consist of neutrons and protons, a curve is obtained showing relations supporting the theory of layers of neutrons and protons. The existence of neutrons n_0^2 is suggested. The position assigned in this way to K_{19}^{41} agrees with that deduced from the period determined by Mühlhoff. [See Abstracts 883 (1931) and 6 (1935.]
C. A. S.

530. High-Velocity Positive Ions. Part IV. Production of Induced Radioactivity by Protons and Diplons. J. D. Cockcroft, C. W. Gilbert and E. T. S. Walton. *Roy. Soc., Proc.* 148A. *pp.* 225–240, *Jan.* 1, 1935.—Targets of B, C and N compounds have been bombarded by protons and diplons of energies up to 600 kV. B is found to become radioactive with the emission of positrons after diplon bombardment, but not after proton bombardment. Different experiments have given values for the half life ranging from 18 to 25 min., although the probable error of a single experiment was of the order of 1 min. C is found to emit positrons after both proton and diplon bombardment, the relative numbers at 550 kV being of the order of 1 to 10, the half life being 11 ± 1 min. Compounds containing N become radioactive after diplon bombardment, the half life being about 3 min., although the experiments have not yet given a conclusive proof that the activity is due to N. Experiments are described in which the recoil of the radioactive nucleus is demonstrated; targets of B and C have been heated to drive off the radioactive gases formed, and experiments on the condensation of these gases by low temperatures have been made. [For Part III see Abstract 2259 (1934).]
AUTHORS.

531. Transmutations of Sodium by Deutons. E. O. Lawrence. *Phys. Rev.*, 47. *pp.* 17–26, *Jan.* 1, 1935.—Under deuton bombardment sodium emits protons, neutrons and α-particles, and becomes radioactive. The radioactive substance, which was shown by chemical tests to be radio-sodium, decays with a half-life of 15·5 hours, emitting electrons with energies up to 1·2 MV, and 5·5 ± 0·5 MV γ-rays. 1 μA of 1·7 MV deutons bombarding a target of NaCl produces about 4×10^6 radio-sodium atoms per sec. The rapid increase in yield with voltage predicted by the Gamow formula has been found, and with the higher current and voltage that soon will be available, the already large yield of radio-sodium just stated should be increased more than 100-fold. Doubtless radio-sodium will find many uses in the physical and biological sciences. The number of emitted protons equals, within experimental uncertainty, the number of radio-sodium atoms created; this supports the view that Na^{24} is the radioactive isotope formed. The protons are distributed in ranges up to 49 ± 2 cm. (air at 20°C, 760 mm.) with a rather pronounced group in the neighbourhood of 17 cm. The number of neutrons, emitted presumably in a reaction in which Mg^{24} is formed, is of the same order of magnitude as the number of protons. The α-particles have a range of 6·5 ± 0·3 cm. and are emitted in a less frequent reaction in which presumably Ne^{21} is formed. Balance of energy in the reactions leads to the following atomic masses: Na^{23}, 22·992 ± 0·001; Na^{24}, 24·000 ± 0·003; Mg^{24}, 23·993 ± 0·003.
AUTHOR.

532. Disintegration of Nuclei of Light Atoms by Neutrons. Part II. Neon, Fluorine and Carbon. W. D. Harkins, D. M. Gans and H. W. Newson. *Phys. Rev.* 47. *pp.* 52–55, *Jan.* 1, 1935.—Using the previous method [see Abstract 4861 (1933)] out of 4800 pairs of photographs with Ne in the chamber 11 pairs indicated disintegration—probably capture of a neutron according to $^{20}_{10}$Ne + $^{1}_{0}n$ = $^{17}_{8}$O + $^{4}_{2}$He, and similarly of 1600 pairs with CF_4 and 3200 with CF_2Cl_2 11 pairs indicated a probable disintegration according to $^{19}_{9}$F + $^{1}_{0}n$ = $^{16}_{7}$N + $^{4}_{2}$He. Kinetic energy relations are calculated and discussed, such energy usually disappearing by transformation into mass or γ-rays, or by excitement of the heavier product with production of radioactivity [see Abstract 3975 (1934)]. With C_2H_4, of 6400 pairs of photographs only one, and that doubtfully, implied a possible disintegration of C according to $^{12}_{6}$C + $^{1}_{0}n$ = $^{9}_{4}$Be + $^{4}_{2}$He. C. A. S.

533. Concentration of Deuterium in Industrial Waters. M. Harada and T. Titani. *Chem. Soc. Japan, Bull.* 9. *pp.* 457–459, *Oct.*, 1934. *In English.*—The D content was found for water obtained from (1) Commercial electrolytic cells, (2) chromium plating baths, (3) lead accumulators, A, B and C, (4) Edison batteries, A and B. The cells had been in use for varying periods of time: (1) for 1 year, (2) for 4 years, (3) for 9 years, and (4) A for 9 months and B for 6 months. The ratio of D : H was 1 : 2100 for (1) and (4) A and B, and reached 1 : 5000 in (3) B and C. The investigation is being continued. F. J. B.

534. Properties of Condensed Heavy Hydrogen. K. Clusius and E. Bartholomé. *Zeits. f. techn. Physik*, 15. 12. *pp.* 545–547, 1934. *Phys. Zeits.* 35. *pp.* 969–971, *Dec.* 1, 1934.—The following values of some of the physical constants of heavy hydrogen (D_2) have been determined. Values of the corresponding constants for H_2 are given for comparison: melting point (°Abs.) D_2, 18·5$^{0}_{9}$, H_2, 13·95°; latent heat of fusion, D_2, 47·0 cal, H_2, 28·0 cal; pressure at triple point, D_2, 127 mm. of mercury (provisional value), H_2, 58·3 mm. of mercury; molecular volume at the triple point, D_2, 23·15 c.c., H_2, 26·15 c.c.; characteristic temperature, Θ, for C_p in the solid state (Debye), D_2, 89°, H_2, 91°. J. S. G. T.

535. Isotopic Ratio in Hydrogen. Density of Water from Various Sources. Part II. H. J. Emeléus, F. W. James, A. King, T. G. Pearson, R. H. Purcell and H. V. A. Briscoe. *Chem. Soc., J. pp.* 1948–1950, *Dec.*, 1934.—The densities of a number of new samples of water have been determined by the methods already described [see Abstract 3985 (1934)]. Two samples from north polar regions had densities 1·36 and 4·2 × 10^{-6} gm./ml. greater than ordinary water, the more northerly sample being the heavier, and are the first samples of natural water occurring in bulk which is not subject to abnormal evaporation, yet is substantially heavy. Deep seated water from Persian oilfields was 1·9 × 10^{-6} gm./ml. heavy. Other results confirm the results of the earlier paper. Finally, results are given for sugar and the fermentation process, and the examined waters are heavy by amounts up to 7·56 × 10^{-6} gm./ml. The reasons for the observed differences often remain obscure. P. H. B.

536. Heavy Water in Chemistry. M. Polanyi. *Nature*, 135. *pp.* 19–26, *Jan.*, 1935.—The importance of the discovery of heavy hydrogen (D), inasmuch as it does not behave as a true isotope, and is separable from H by chemical means, is discussed. The chemical differences between the two forms and dissimilarities in the energy content of their compounds cannot be explained by the differences in their thermal velocities, but can be accounted for on the basis of the uncertainty principle from which it can be shown that the uncertainty motion, and the energy of this motion of the atoms, due to restriction in their positions when linked up in a compound, are greater for H than for D. This *permanent* energy and motion, being present only in molecules, vanishes when the atoms are set free; in the molecule, however, it must, unlike thermal energy, last for ever. From data for the halides it is shown that the differences in the permanent energies of corresponding compounds of H and D fall off in the sequence of decreasing bond strength. This relation of the permanent energy of compounds is examined with the help of interchange reactions of substances containing H and D, the D being unequally distributed between the two reacting substances. Such reactions suggest possible methods of concentrating D, or of preparing the more complex substances containing it when direct synthesis would be unsuitable. The relation of such replacement to the process of hydrogenation of organic compounds and the practical interest of the low reactivity of D compounds are discussed. Attention is drawn to the probability of elucidating the mechanism of reactions such as oxidation and hydrolysis by means of D and of heavy oxygen, O^{18}. N. M. B.

*537. **Separation of Neon Isotopes by Rectification. W. H. Keesom, H. van Dijk and J. Haantjes.** *K. Onnes Lab. Leiden, Comm. No.* 234d. *K. Akad. Amsterdam, Proc.* 37. 9. *p.* 615, 1934. Abstract. *Physica,* 1. *pp.* 1109–1114, *Dec.,* 1934. *In English.*—A rectifying apparatus with 60 pans, entirely made of glass, has been constructed. It consists principally of the column proper of about 2 m. length, an outer Dewar glass of the same length and above these glasses another vacuum vessel of special construction, to contain the cooling liquid, in this case liquid hydrogen. The rectification was divided into three periods. In the first period the liquid was rectified for 18 hr. without taking off any gas. At the end of this time a sample (I) of 4 l. was taken from the condensation space. In the second period of 64 hr. a quantity of 280 l. neon gas was regularly taken off from the condensation space. In the third period of 10 hr. rectification was again carried out without taking off anything. At the end of this last period a sample (II) of 5 l. was taken from the still. 300 l. liquid hydrogen were used in the cooling. The gas density determinations gave as results: (I) $S_{0_I} = 0 \cdot 00089580$ atomic weight 20·091; (II) $S_{0_{II}} = 0 \cdot 00091733$ atomic weight 20·574; $S_{0_n} = 0 \cdot 00089990$ atomic weight 20·183. S_0 is the density at standard conditions, S_{0_n} is the density of normal neon. It appears that the efficiency of the column is about 50 % of the theoretical value. The better results than those formerly obtained may be attributed to the great number of pans, a large reflux ratio and a greater regularity of the rectification process. AUTHORS.

538. Element 91. A. V. Grosse. *Science,* 81. *pp.* 512–516, *Dec.* 7, 1934.—The history of the search for the missing element, leading to the isolation of Pa_2O_5, is briefly reviewed. The element is represented by three natural radioactive atomic species or isotopes: brevium or uranium X_2, protactinium, and uranium Z, and the artificial isotopes radio-brevium I and II. The chemical properties of the metal ekatantalum and of the compounds Et_2O_5, and $Et\,Cl_5$ are described; the atomic weight of protactinium was found to be 231 ± 0·5 by converting K_2PaF_7 into Pa_2O_5. The general radioactive properties of the five isotopes, the protactinium and radium content of minerals, and the actinium radioactive series are tabulated and discussed. A description is given of the origin and occurrence in nature of the element and its technical extraction, together with a short account of experiments leading to the artificial isotopes. N. M. B.

539. Valency Angles of Oxygen and Sulphur. N. G. Pal. *Indian Journ. Phys.* 9. *pp.* 121–130, *Nov.*, 1934.—The valency angles of O and S atoms are calculated for a number of simple molecules from their fundamental frequencies of oscillation, and their dipole moments. AUTHOR.

***540. Molecular Models. H. A. Stuart.** *Zeits. f. phys. Chem.* 27. *Abt.B.* 5–6. *pp.* 350–358, 1934.—From the data available the radii of the effective spheres of combined atoms are calculated, and from the values obtained new molecule models have been constructed. Some of these are of glass with small spheres blown inside to show the arrangement of the framework of the nucleus and the space-filling. Others of wood, representing the most important atoms, allow of the construction of any molecule model and permit the different forms of non-rigid molecules possible owing to free rotation to be studied. T. H. P.

541. Theory of Free Radicals and Organo-Alkali Compounds. B. Nilsen. *J. Chem. Phys.* 3. *pp.* 15–19, *Jan.*, 1935.—The theory of the free radicals of Pauling and Wheland [see Abstract 3288 (1933)] is applied to the electron affinities of the radicals. The results are compared with the measurements of Bent, and they indicate that the charging electron enters in resonance with the whole system of $[p]_h$-electrons. The theory is generalised to unsaturated hydrocarbon radicals and it is shown that the formation of ionisable metal derivatives is due to the resonance between the charging electron and the $[p]_h$-electrons. Some cases of anomalous reactions of organo-alkali compounds are also interpreted. AUTHOR.

See also Abstracts **547, 548, 599, 604, 672, 734, 735, 752, 753, 783, 784 791, 803, 820, 836, 842, 852, 861, 880.**

COLLOIDS.

542. Theory of Coagulation. N. Fuchs. *Zeits. f. phys. Chem.* 171. *Abt.A.* 3–4. *pp.* 199–208, 1934.—The fundamental equation of v. Smoluchowski's theory of rapid coagulation is derived according to the method of Kolmogoroff and Leontowitsch [see Abstract 4361 (1933)] and the edge condition is discussed. It is shown that the objections recently raised against the fundamental validity of this theory are groundless, but that the theory requires an important correction, the magnitude of which depends on the value of λ/a, where a is the particle-radius and λ the mean path of the particle in a certain direction. With colloidal solutions this correction has a vanishing value, but with aerosols it cannot be neglected. The velocity of coagulation, which v. Smoluchowski takes as simply proportional to the effectivity α of the elementary impacts, actually depends on α to an extent diminishing as λ/a decreases. In the theoretical interpretation of the results of experiments on the stabilisation of disperse systems, it is essential that this circumstance be taken into account. T. H. P.

543. Theory of Cataphoresis and Electroosmosis. J. J. Bikerman. *Zeits. f. phys. Chem.* 171. *Abt.A.* 3–4. *pp.* 209–220, 1934.—The velocity of formation of the double layer was calculated on the basis of the theory of the diffuse double layer and the limits of the " voltage effect " in colloids are approximated. The " break " effect is shown to be identical with the " relaxation " force of Debye's theory of electrolytes. Explanations are advanced for the apparent deviation of the ζ-potential for membrances with fine pores and for the general relationship between the velocities of cataphoresis and electroosmosis. F. J. B.

544. Dependence of Electrokinetic Potential at Ceramic Diaphragms on Current Strength. J. Velišek and A. Vašiček. *Zeits. f. phys. Chem.* 171. *Abt.A.* 3–4. *pp.* 281–285, 1934.—It is shown that the quantity of solution transported in 1 sec. through ceramic diaphragms is proportional to the applied current strength. A formula is developed for the calculation of ζ, the electrokinetic potential, over a range of concentrations of the solutions investigated. ζ was found to be independent of the current strength. The result is in agreement with the theory of Helmholtz-Smoluchowski, but in opposition to the results of Schönfeldt, who found a dependence of ζ upon current strength for the same ceramic diaphragms.

F. J. B.

545. General Discussion on Colloidal Electrolytes. *Faraday Soc., Trans.* 31. *pp.* 1–422, *Jan.*, 1935.

General Introduction.

H. Freundlich (*pp.* 4–10).—Colloidal electrolytes are " pure " substances in the sense that their electrical properties are the result of the electrical properties of intrinsic parts of the molecules which form the colloid particles. These colloids are to be distinguished sharply from those whose electrical properties are the result of foreign ions bound to the micelle by adsorption or loose chemical linkage. Soaps are a typical example of the first class and gold of the second. The micelles of soap break down into small monomer ions but some colloidal electrolytes, such as the proteins, do not. Others, such as some dyestuffs, are intermediate in that they are sensible to dilution but the smallest particles still do not diffuse through membranes.

Part I. General: (A) Theory.

W. Pauli (*pp.* 11–27).—On the complex nature of the ionogenic surfaces of colloid particles, with special reference to Au and Pt. The colloid is not stabilised by ions simply adsorbed but by a complex ion.

H. R. Kruyt (*pp.* 28–31).—The behaviour of colloid particles may be considered from the Helmholtz-Goüy theory of the electrical properties of macro-surfaces or from the properties of the ions of ordinary electrolytes. Either view involves considerable extrapolation. AgI sols can be made stable by either Ag or I ions. Other ions can cause an increase of the ζ-potential but without adding to the stability of the sol. In addition to the surface ionisation there is at the surface of a colloid particle some other source of electrokinetic activity. The charge due to this latter is always negative when water is the dispersion medium. It occurs on inert surfaces, such as paraffin, as well as on ionogenic ones and on lyophilic micelles such as gum arabic.

G. S. Hartley (*pp.* 31–50).—Discussion of the application of the Debye-Hückel theory to colloids. It is concluded that there must exist association between micelles and ions of the opposite charge. The effect of this association may be greater than direct ionic atmosphere effects.

A. J. Rabinovitch and **V. A. Kargin** (*pp.* 50–66).—There must be some of each of the ions peptising a colloid in the intermicellar liquid. This follows whether the stabilising ion is simple or complex. ζ-potentials must be considered in this light. Potentiometric measurements are actually measurements of the equilibrium concentrations of both of the stabilising ions, not in the outer layer of the electrical double layer but in the intermicellar liquid. Colloidal acids behave in a peculiar manner on dilution; their apparent acidity increases.

F. G. Donnan (*pp.* 80–98).—Thermodynamical. Application of the membrane equilibrium theory to determination of osmotic pressures, molar masses and electrovalencies of colloidal electrolytes.

G. S. Adair (*pp.* 98–106).—Application of the membrane equilibrium theory to systems of many components such as protein salts.

M. Proskurnin and **A. Frumkin** (*pp.* 110–115).—A new determination of the capacity of the electrical double layer gives results in agreement with those calculated by the electrocapillary equation. The influence of organic impurities is great.

I. Kemp and **E. K. Rideal** (*pp.* 116–120).—Measurements have been made of the rate of cataphoresis of gliadin sols and of quartz particles covered with gliadin. The results are compared with those calculated by the Debye-Henry equation and discrepancies discussed.

J. L. Moilliet, B. Collie, C. Robinson and **G. S. Hartley** (*pp.* 120–129).—Discussion on determination of mobilities of colloidal electrolytes.

(B) Methods and Experimental Technique.

G. S. Adair and **M. E. Adair** (*pp.* 130–135).—Methods available for determination of the electric charge of colloidal ions.

H. B. Oakley (*pp.* 136–147).—A new type of osmometer is described and its application to gum arabic sols.

Part II. Special and Technical:

(A) Soaps and other Long-Chain Colloidal Electrolytes.

J. W. McBain and **Margaret M. Barker** (*pp.* 149–152).—The activities of sodium and potassium soaps have been calculated. Those of the higher soaps in concentrated solution simulate those of a half-weak electrolyte with dissociation constant 0·01, the effect being due to formation of colloid. In more dilute solution, the soaps are moderately strong electrolytes.

M. E. L. McBain (*pp.* 153–164).—Discussion of the relation between electrokinetic and electrolytic movement with special reference to soap curds. Electrochemical and electrokinetic quantities are shown to be completely interchangeable.

J. L. Bowen and **R. Thomas** (*pp.* 164–182).—Observations of contraction of, hardness of, and diffusion in, solid commercial soaps. These properties are related to the structure of the soaps.

R. C. Murray and **G. S. Hartley** (*pp.* 183–189).—The form of the solubility curves of long-chain colloids is determined by the mass action law and the concentration of micelles containing m molecules per micelle will be proportional to the mth power of the concentration of monomer.

A. S. C. Lawrence (*pp.* 189–195).—Two distinct types of colloid aggregation occur in soaps. (*i*) true colloidal association of hydrocarbon chains, and (*ii*) association of the primary micelles by their exterior polar groups. Sodium soaps are shown to be a new crystalline phase distinct from curd in soft soaps.

A. Lottermoser (*pp.* 200–204).—CO_2 has large effects upon the value of the surface tension of soap solutions.

A. Stewart and **H. M. Bunbury** (*pp.* 208–215).—Some industrial applications of colloidal electrolytes.

(B) Dyestuffs.

E. Elöd and **T. Schachowskoy** (*pp.* 216–230).—Examination by light absorption measurements of the tanning effect of complex chromium salts upon gelatin.

E. Valkó (*pp*. 230–244).—Measurements of the diffusion rates of dyestuffs and detection of colloidal aggregation.

C. Robinson (*pp*. 245–253).—Osmotic pressure, mobility and diffusion rates of some dyes have been measured and the colloidal association computed. Conductivity measurements show colloidal association in methylene blue, a dye usually considered to be molecularly dispersed.

T. H. Morton (*pp*. 262–276).—Dyeing of cellulose with direct dyestuffs. The pore size of viscose cellulose is of the same order of magnitude as the dyestuff molecule. Micelles will not therefore be able to penetrate, and it is necessary to assume a labile equilibrium so that, at any moment, there will be particles of all sizes from monomer to maximum association. The distribution of particle sizes is discussed and it is shown that the observed dyeing kinetics can be explained. Ultrafiltration experiments show that colloidal association is greatest in those dyes which dye slowly.

(C) Silicates and Silicic Acid.

V. A. Kargin and **A. J. Rabinovitch** (*pp*. 284–297).—Examination of very pure silica sols prepared (*a*) by hydrolysis of $SiCl_4$ followed by dialysis and electrodialysis, and (*b*) by oxidation of SiH_4 by ozone. These sols have only the electrical conductivity of pure water. Their stability is attributed to the lyophilic nature of silicic acid since there are not sufficient foreign stabilising ions to be detected.

W. D. Treadwell (*pp*. 297–302).—Silicic acid was prepared by electrolysis of sodium silicate with a mercury kathode. Polymerisation phenomena were noted.

(D) Proteins.

E. Elöd (*pp*. 305–317).—Concerning the mechanism of taking up of dyestuffs and of mordanting.

Dorothy Jordan-Lloyd (*pp*. 317–324).—Discussion of proteins as colloidal electrolytes.

K. Linderstrøm-Lang (*pp*. 324–335).—Electrochemical properties of clupein.

E. J. Bigwood (*pp*. 335–348),—Chemical reactions between gelatin and electrolytes in gelatin gel give a distribution corresponding to the Donnan membrane equilibrium for sodium and calcium chlorides but not for magnesium sulphate.

E. B. R. Prideaux (*pp*. 349–354).—Diffusion potentials and mobilities of ionised gelatin in acid and neutral solution.

F. Weigert (*pp*. 359–365).—Observations on the intergranular colloidal matter in photographic emulsions and discussion of the photochemical processes.

T. Caspersson, E. and **H. Hammarsten** (*pp*. 367–389).—Interactions of proteins and nucleic acid.

R. K. Schofield (*pp*. 390–394).—Metaphosphoric acid and proteins.

(E) Other Substances.

M. Samec (*pp*. 395–410).—Starch owes its electric charge mainly to phosphoric acid which is present as ester of the polysaccharide. The size of the starch ion, from osmosis, is about 200,000.

A. Lottermoser (*pp*. 411–414).—Fine wood fibres as colloid electrolytes.

F. Eirich (*pp*. 415–421).—A new type of tungstic oxide sol and its electrochemical behaviour. A. S. C. L.

546. Anomalous Flow of Colloidal Solutions. A. S. C. Lawrence. *Roy. Soc., Proc.* 148*A. pp.* 59–87, *Jan.* 1, 1935.—Colloidal solutions which do not obey the Poiseuille equation for flow through a cylindrical tube have a non-parabolic velocity distribution across it. Direct observation has been made of the velocity distribution in a number of colloidal systems. The various types of anomaly known are described and their origin discussed. A quantitative proof is given of the correctness of Staudinger's theory of the effects of fibrillar micelles on viscosity and some limitations indicated. The bearing of these results on the sol-gel transition is discussed. A. S. C. L.

547. Fine Structure of Wood. Swelling of Deal and Lignin in Various Media. H. Saechtling and H. Zocher. *Kolloid-Beihefte,* 40. 7–12. *pp.* 413–448, 1934.—The conditions affecting the swelling of wood are explained on the basis of the structure of wood-substance, as indicated by botanical, morphological, chemical and X-ray investigations. Swelling is hindered by the spiral arrangement of the anisotropically-swelling cellulose micelles and also by the varying inclinations of the spirals in the primary and secondary layers. Hence bending or sliding within the micelle structure is necessary. The rôle of the lignin is less well defined, but its presumably isotropic swelling should produce further deformation. Swelling is also hindered in intercellular dimensions by the lignin network in the median lamellæ and, especially radially, by the pith. Diminution of swelling due to ageing is regarded as due to irreversible densification of the structure by reactions rendered possible by bending and sliding within the cell-walls. The changes in the dimensions of wood and lignin caused by steeping them in various liquids and subsequently gradually drying them are recorded and discussed. T. H. P.

***548. X-Ray and Electron Study of Disperse Systems, Threads, Films and Boundary Layers.** *Kolloid Zeits.* 69. *pp.* 264–394, *Dec.,* 1934.—An introductory address, followed by papers dealing with special aspects of the subject :—

" Introductory Remarks," by **W. Ostwald** (*pp.* 264–266).—Describes the scope of the following papers and discusses the mutually beneficial relations between the study of colloids and that of X-ray and electron analysis.

" X-Ray Study of Disperse Systems (with Reference to Electron Interference)," by **E. Schiebold** (*pp.* 266–301).—The fundamentals of X-ray interference in crystals, etc., are discussed under the headings : The crystal as space-lattice ; the deflection of X-rays at crystal lattices ; the interference of material waves, especially of kathode rays (electron waves) at crystal-lattices and net-planes ; the dependency of X-ray and electron interferences on the particle size. Special X-ray interference methods for crystalline systems are detailed, X-ray analysis of macroscopic systems (single crystals and crystalline aggregates), and X-ray and electron analysis of microscopic systems being considered. X-ray and electron interference with non-crystalline (so-called amorphous) substances (liquids, glasses, resins, etc.), and the X-ray analysis of transition states between crystalline and amorphous matter are also discussed.

" Determination of Particle Size by Means of X-Rays and Electron Rays," by **R. Brill** (*pp.* 301–312).—The foundations of this process are outlined simply and without mathematical treatment, and the practical procedure to be followed is described with the help of examples. Experience in the determination of particle size by means of electron rays is not yet extensive enough to allow of definite evaluation of the applicability of the method.

"X-Ray and Electron Investigation of Inorganic Gels, especially of Hydroxides and Oxides," by **R. Fricke** (*pp.* 312–324).—After a short review of the literature, the results obtainable by X-ray examination—in conjunction with other methods—of inorganic gels are considered. The conclusions arrived at with regard to the structure of hydroxides and active oxides are recorded, attention being paid particularly to aluminium, beryllium, ferric and zinc hydroxides. The nature of the combination of water in crystalline hydroxides is discussed.

"X-Ray Analysis of Organic Gels," by **F. Halle** (*pp.* 324–340).—The changes occurring in X-ray diagrams on passing from the ideal gas to the crystal are outlined, and the diagrams obtained with various types of organic gel are considered more in detail. The modifications produced in the diagrams by the various types of swelling to which such gels are subject are indicated. Various conclusions concerning the molecular structure of the crystalline portions of certain gels are enumerated.

"X-Ray Analysis of Protein Fibres," by **W. T. Astbury** (*pp.* 340–351).—The molecular structures of silk fibroin, hair, skin, muscle, etc., are considered. Results of the study of the grid structure of keratin are summarised, the conclusion being drawn that α-keratin may be regarded as a labile form intermediate to the completely expanded β-keratin and completely contracted (over-contracted) keratin. The important reversible changes in configuration—due to physical and chemical modifications in the surrounding medium—rendered possible by the grid arrangement are indicated. The similarity in the X-ray diagrams of proteins other than those having well-defined, visible fibrous structure is emphasised.

"X-Ray Study of Lamellar-Disperse Systems," by **U. Hofmann** (*pp.* 351–357).—Lamellar-disperse distribution is shown by the crystals of graphite oxide and montmorillonite. The absorption of water by graphite oxide and the consequent swelling with increase in the separation of the layer-planes, and the different reactions involved in thermal decomposition of the oxide and in its reduction by hydrogen sulphide are described. Similar unidimensional swelling in polar liquids is exhibited by montmorillonite. Further reactions proceeding in this lamellar-disperse manner are considered.

"X-Ray Spectrographic Investigation of the Structure of Biological Substances and Human Tissues," by **E. Saupe** (*pp.* 357–363).—Investigations have been made on the structures of bone (with two inorganic and one organic lattice), teeth, egg-shells, kidney- and similar stones, muscles, nerves, etc.

"X-Ray Investigation of the Texture of Metals," by **F. Wever** (*pp.* 363–368).—Work on the textures of cold-drawn, cold-pressed, and cold-rolled metals is discussed. Under such treatment metals assume anisotropic properties, and hence become unsuitable for certain purposes. This disadvantage is aggravated by the fact that numerous metals, even after recrystallisation, still exhibit a texture, either the formation-texture persisting or a peculiar recrystallisation texture being set up. Hence, it is frequently impossible to restore the desired approach to isotropy in properties destroyed by cold-treatment.

"Investigation of the Structure of Boundary Layers by Means of X-Rays and Electrons," by **E. Rupp** (*pp.* 369–378).—The principles on which depends the application of the scattering of X-rays and electrons at surfaces to the determination of the arrangement of atoms and molecules are explained. These principles are applied to the cases of: deflection of X-rays at liquids; deflection of electrons at organic substances; interference and the thickness of oil layers; deflection of electrons at polished surfaces; solid boundary layers; photo-electric surfaces, and surface catalysis.

"Electron Deflection and its Application to the Study of Organic Compounds," by **J. J. Trillat** (*pp.* 378–388).—The principles of the method of electron analysis and its application to the study of the structure of organic compounds are explained, and the necessary apparatus and experimental procedure are described. The special substances considered are: carbon in its various forms; paraffin hydrocarbons and fatty acids; cellulose and its derivatives; rubber, etc.

"Electron Microscope and its Application, especially to the Study of Thin Films on Metals," by **E. Brüche** (*pp.* 389–394).—The principle of the method and the experimental arrangement, the procedure followed in the examination of passive and active films, and the use of a layer of barium in metallurgical observations, are considered. T. H. P.

549. Are Liquid Sodium-Amalgams Colloidal? R. M. Joshi. *Indian Journ. Phys.* 9. *pp.* 153–159, *Nov.*, 1934.—All the important arguments raised by Bent [see Abstract 2826 (1933)] are considered and it is attempted to show that the probability of dilute liquid sodium-amalgams being colloidal systems is greater than Bent admits. AUTHOR.

See also Abstracts 570, 578, 612.

CRYSTAL STRUCTURE AND PROPERTIES.

550. Dynamical Theory of the Diamond Lattice. N. S. N. Nath. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 333–345, *Nov.*, 1934.—Calculations of the characteristic frequency of the diamond lattice and experimental results on the vibration spectra are briefly reviewed. The vibratory equations of motion of the lattice under the three-force system and intravalency forces are formulated. A typical factor of the secular equation is then obtained and is found to correspond to the vibration of the two component face-centred lattices relative to one another, each being regarded as rigid. The vibration is triply degenerate and optically inactive, but is the origin of the principal Raman frequency with the shift 1332 $cm.^{-1}$, the corresponding infra-red band being absent. N. M. B.

551. Theory of the Lithium-Bromide Crystal with Consideration of the Polarisation Effect. P. Gombás. *Zeits. f. Physik*, 92. 11–12. *pp.* 796–814, *Dec.* 10, 1934.—The most important constants of the LiBr crystal as well as the lattice constant, lattice energy, compressibility and the infra-red characteristic frequency are calculated. The electron density of the Br^- ions is taken into account according to the approximate solution of the Thomas-Fermi equation given by Lenz and Jensen; the electron density of the Li^+ is obtained with the help of the characteristic function. The polarisation energy arising from the constant ionic charge and the van der Waals energy are considered. For the calculation of the polarisation energy in the case of small kations a new process is developed. The calculated constants agree well with those found experimentally. J. J. S.

552. Structure of Mg_3Sb_2 and Zn_3Sb_2. K. Löhberg. *Zeits. f. phys. Chem.* 27. *Abt. B.* 5–6. *pp.* 381–403, 1934.—From powder and rotation photographs it is found that the structure of Mg_3Sb_2 and Zn_3Sb_2 is trigonal. Mg_3Sb_2 dissolves up to 46 % (atomic) Zn_3Sb_2 the axial ratio changing from 1·581 to 1·636. The space group is C^1_{3i}, D^2_3 or D^3_{3d}. The atomic positions and parameters are given. The Mg atom at (0,0,0) is not replaceable by Zn but in the other positions the Mg and Zn atoms are interchangeable. The values of the interatomic distances, and the fact that an increase in Zn content is accompanied by a reduction in lattice size, lead to the conclusion that the atoms are in the same state as in the pure metals. J. T.

553. Structure of Au_2Pb. H. Perlitz. *Univ. Tartuensis, Acta et Comm. A.* 27. [15 *pp.*], 1934. *In English.*—From X-ray powder photographs it is concluded that the structure of Au_2Pb is of the same type as that of $MgCu_2$ and KBi_2. The unit cube contains 24 atoms and the length of the edge is 7·91Å. J. T.

554. Properties of Pure α-, β- and γ-Manganese. F. Brunke. *Ann. d. Physik,* 21. 2. *pp.* 139–168, *Oct.,* 1934.—The physical properties of the 3 modifications of pure Mn are briefly reviewed. Thin layers of pure α-Mn are prepared by distillation *in vacuo* of pure Mn ; small specimens of β- are obtained by quenching pure Mn from 1100° C. and thin foil of γ-Mn by electrolysis of aqueous solutions of $MnCl_2$ and NH_4Cl. The electrical conductivities and specific resistances of the 3 types are measured and the temperature coefficients of resistance over the range 20 to −79° C. are given. The electrical properties lead to the conclusion that the α- and β-phases may be regarded as solid solutions of γ-Mn. Phase changes are considered with particular reference to the results of X-ray analysis. The magnetic properties of the 3 types and the reflecting power of α-Mn are examined. H. J. H. S.

555. Oxidation of Metals. Part I. G. D. Preston and L. L. Bircumshaw. *Phil. Mag.* 19. *pp.* 160–176, *Jan.,* 1935.—Oxide films formed on lead and tin have been examined by the electron diffraction method. The films have been studied at room-temperature by removing them from the molten metal on wire loops and by preparing them by heating foils supported on wire loops. Photographs have also been obtained of the films formed on molten drops of these metals at temperatures a little above their melting-points. The oxide films of tin yield diffraction photographs characteristic of the usual SnO_2 structure—a tetragonal cell of side 4·72 Å and height 3·17 Å. Traces of SnO are possibly present, and the SnO_2 film is probably orientated with the " c "-axis perpendicular to the surface of the drop. The oxide films of lead prepared by heating foil and by removing the oxide from the molten metal consist of orthorhombic (yellow) PbO, with possibly traces of the tetragonal (red) modification. They show orientation with the " c "-axis perpendicular to the plane of the film. The oxide film on drops of molten lead is tetragonal (red) PbO ; orientation of these films has not been detected. AUTHORS.

556. Structure of Rhombic Sulphur. B. E. Warren and J. T. Burwell. *J. Chem. Phys.* 3. *pp.* 6–8, *Jan.,* 1935.—From rotation and oscillation photographs with Mo Kα, rhombic sulphur is found to have the following cell and space group ; $a = 10·48$ Å, $b = 12·92$ Å, $c = 24·55$ Å, $Z = 128$, space group $V_h^{24}(Fddd)$. The structure contains S_8 molecules which are symmetrical puckered rings with S − S distance 2·12 Å and bond angle $\alpha = 105°$. The atomic coordinates are determined by comparison of calculated amplitudes with visual intensity estimates from oscillation photographs. The relation of rhombic sulphur to the high-temperature forms is discussed briefly. AUTHORS.

557. Structure of Cyanuric Triazide. E. W. Hughes. *J. Chem. Phys.* 3. *pp.* 1–5, *Jan.*, 1935.—Hexagonal cyanuric triazide has been examined by means of Laue, rotation and oscillation photographs and by a few spectrometer measurements. The dimensions are $a = 8 \cdot 70$ Å and $c = 5 \cdot 98$ Å. The space group is $H6_3/m$. There are two $C_3N_3(N_3)_3$ in the cell. The ten parameters have been determined by a qualitative Fourier analysis and the dimensions and angles of the molecule are given. AUTHOR.

558. Structure of Guanidonium Iodide, $C(NH_2)_3I$. W. Theilacker. *Zeits. f. Krist.* 90. *pp.* 51–76, *Jan.*, 1935.—The compound is dihexagonal pyramidal, with the space group C_{6v}^4. The elementary cell contains four molecules, and has dimensions as follows: $a = 7 \cdot 19 \pm 0 \cdot 01$ Å, $c = 12 \cdot 30 \pm 0 \cdot 03$ Å. The configuration is planar, and the C–N distance is $1 \cdot 18$ Å. [See also Abstracts 1781 (1931) and 724 (1935).] F. I. G. R.

559. Orientation of Anisotropic Liquids in Thin Layers and Measurement of Some of Their Elastic Constants. V. Fréedericksz and V. Zwetkoff. *Phys. Zeits. d. Sowjetunion*, 6. 5. *pp.* 490–504, 1934. *In German.*—The refraction exponents of para-azoxyanisol for different temperatures were measured by means of the orientation of the substance in the magnetic field and observation of the limits of total reflection. A method is worked out for fixing the position of the molecular axes in layers of different thickness under the action of a magnetic field. Fair agreement with experiment was found. It is established that between the magnitude of a magnetic field H and the thickness of a layer Z_φ, in which the molecules have turned through a definite angle ϕ, a relation $Z_\varphi \cdot H = K_\varphi$ exists, where K_φ in the particular substance and for the relative values of ϕ and of the temperature, is constant. A sort of "torsion" constant was measured for *p*-azoxyanisol under the influence of a magnetic field. J. J. S.

560. Nucleus Formation on Crystals of Cupric Sulphate Pentahydrate. N. F. H. Bright and W. E. Garner. *Chem. Soc.*, *J. pp.* 1872–1877, *Dec.*, 1934.—Single crystals of $CuSO_4, 5H_2O$ were dehydrated in vac., and the rate of formation and growth of nuclei determined between 10 and 40°. In all cases an induction period before the appearance of visible (i.e. $\nless 10^{-3}$ cm. long) nuclei was observed. The length of this period decreases with rise in temperature, and its course depends on the state of the surface of the crystal. The nuclei formed during it are probably due to the presence of foreign particles, and the period to their slow rate of growth when very small. Its critical increment is 16 k. cal. After the period the number of nuclei increases linearly with time. The nuclei are star-shaped with two main directions in the (110) face, and the third about 56° thereto. Variations in rate of growth in the different directions are probably due to Smekal cracks. C. A. S.

561. Nature of the Red "Hood" Formed at the Boundary of the Coloured Zone in Alkali Halide Crystals. S. Arzybyšev and A. Toporec. *J. de Physique et le Radium*, 5. *pp.* 619–622, *Dec.*, 1934.—In the case of NaCl crystals coloured by addition and without application of an electric current a red hood forms round the coloured regions and is separated from them by a clear portion. In cases where coloration is produced by a current the "hood" forms near to the anode. Observations with a quartz spectroscope and photoelectric cell show that there is strong ultra-violet absorption not only in the coloured regions but also in the clear regions. This indicates that there are undeveloped colouring centres in this region. These are probably electrons With crystals coloured by a p.d. applied at Cu electrodes, the absorption curves indicate the responsibility of Cu ions. An investigation on the phosphorescence of the coloured crystals showed that the only parts which are at all intense are the uncoloured parts. The general conclusion is that both the red hood and the phosphorescence are due to penetration of Cu ions into the crystals. [see Abstract 864 (1935)]. J. E.

562. Loss in Tenacity of a Deformed Crystal on Recovery. M. Kornfeld. *Phys. Zeits. d. Sowjetunion*, 6. 3. *pp*. 329–342, 1934.—The previous work of the author [see Abstract 1817 (1934)] is extended by means of a more accurate system of measurement to a study of the relation between the loss in tenacity of a deformed Al crystal and both the degree of initial deformation and the recovery temperature. The relation previously found between the yield points and the recovery temperature over a small range of temperature is established for a larger temperature range. It is found that, above 550° C., a second steady fall occurs in the yield points as the annealing temperatures are increased until finally the original properties of the crystal are reproduced. An explanation of the process of recovery is offered. H. J. H. S.

563. Mechanical Behaviour of Single Crystals of Mercury. E. N. da C. Andrade and P. J. Hutchings. *Roy. Soc., Proc.* 148A, *pp*. 120–146, *Jan*. 1, 1935.—In the mercury crystal the rhombohedral faces are glide planes, and the short diagonal is the glide direction. The crystal twins under strain on a plane through the long diagonals of two opposite faces, acting as glide planes. In simple glide twinning takes place when the twinning plane makes an angle of 45° with the axis of the wire, at any rate if the glide direction approximately coincides with the projection of the tension on the glide plane. The rhombohedral face and the hexagonal basal plane are equally close-packed, but the former contains a much more closely packed line than does the latter. It is suggested that this is why the former acts as glide plane in preference to the latter, on which glide has never been detected. Double and triple glide can take place, according to the ordinary laws governing the glide plane and glide direction. Hardening on one set of glide planes hardens the whole crystal. The critical shear stress at – 43° C. is 9·3 gm. wt. per sq. mm. The very purest mercury gives, in the early stages of stretch, an average spacing of the glide planes which is 0·0054 cm., agreeing closely with that for ordinary pure mercury, and for mercury deliberately contaminated. The appearance of preferred glide planes separated by about 15,000 lattice spacings is thus not due to impurities or dissolved gas. Under constant stress the single crystal flows at a rate which diminishes to a constant value. AUTHORS.

564. Structure Determination by Fourier Method. A. Hettich. *Zeits. f. Physik*, 92. 7–8. *pp*. 528–532, *Nov*. 30, 1934.—It is shown that for certain substances a direct method of crystal analysis may be employed instead of a method of trial and error. J. T.

565. Rotating-Crystal Photograph. N. Seljakow. *Zeits. f. Physik*, 92. 7–8. *pp*. 543–546, *Nov*. 30, 1934.—The relationship between a rotating-crystal photograph and the stereographic projection of the crystal is considered. J. T.

566. X-Ray Investigation of Changes. J. Böhm and P. Feldmann. *Zeits. f. phys. Chem*. 27. *Abt.B*. 5–6. *pp*. 425–430, 1934.—The film carrier of an X-ray goniometer is moved, during the taking of an X-ray diffraction photograph, in such a way that a continuous record is obtained of any changes which take place in the diffraction pattern. As an example the recrystallisation of platinum black is studied, the specimen being heated *in situ*. The application to electron diffraction methods is also discussed. J. T.

567. Determination of Grain-Number in the Region 1–100μ on the Basis of Debye-Scherrer Photographs. H. S. Schdanow. *Zeits. f. Krist.* 90. *pp.* 82–91, *Jan.*, 1935.—The number of interference spots can be made to yield a determination of grain-number. The process is applied to copper recrystallisation. F. I. G. R.

568. Reproduction and Judgment of Debye Photographs. K. Meisel. *Zeits. f. Krist.* 90. *pp.* 92–95, *Jan.*, 1935.

See also Abstracts **548, 674, 701, 717, 724, 725, 744, 781, 782, 784, 809, 859.**

DENSITY.

***569. Determination of Small Density Changes in Water. E. Hofer.** *Zeits. f. phys. Chem.* 27. *Abt.B.* 5–6. *pp.* 467–472, 1934.—By an apparatus based on that of Gilfillan and Polanyi [see Abstract 5136 (1933)] changes in the density of water were measured with an accuracy of 5×10^{-7} gm./ml. Details of the author's apparatus, its standardisation, and measurements therewith are given. P. H. B.

See also Abstract **535.**

DIFFUSION AND OSMOSIS.

570. Permeability of Synthetic Film-Forming Materials to Hydrogen. T. P. Sager. *Bureau of Standards, J. of Research*, 13. *pp.* 879–885, *Dec.*, 1934.—The permeabilities to hydrogen of a number of synthetic film-forming materials spread on closely woven cotton fabric have been determined. Of the films studied, those in which the molecule is rich in hydroxyl groups, regenerated cellulose sheet and polyvinyl alcohol being examples, show very low permeabilities. Cellulose esters and polyvinyl acetate on the contrary give high values. A rough parallelism may be said to exist between the permeabilities of continuous films and the solubility of hydrogen in corresponding types of compounds of simple structure. A comparison of the permeabilities explains the extensive use of materials having hydrophilic-colloidal properties as coating materials for gas-cell fabrics. That satisfactory coating materials may not be limited to highly hygroscopic substances is indicated by the permeabilities obtained with several materials less affected by moisture. AUTHOR.

571. Diffusion of Potassium Chloride in Aqueous Solution. J. W. McBain and C. R. Dawson. *Roy. Soc., Proc.* 148A. *pp.* 32–39, *Jan.* 1, 1935.—The highly-conflicting values given in standard tables for the diffusion coefficient of KCl are compared with integral and differential results obtained with the porous membrane method, using sintered glass discs. Of the former those of Öholm are most nearly correct, and of the latter the data of Clack are most nearly in conformity with the new data. In concentrated solution the ions of KCl are much more mobile even than at infinite dilution. This very rapid and simple method appears to be amongst the most precise and trustworthy yet available, and it is readily adapted to the study of all problems of diffusion. AUTHORS.

See also Abstract **864.**

ELASTICITY AND PLASTICITY.

572. Elastic Moduli of Cubic Metals. D. A. G. Bruggeman. *Zeits. f. Physik,* 92. 9–10. *pp.* 561–588, *Dec.* 7, 1934.—A method of calculating the elastic moduli of cubic metals for different "textures" is developed. The method is applied to Al, Ag, Au, Fe, Cu, and W, for various "textures." J. T.

573. Torsion of a Prismatic Cylinder with ⊂ Shaped Section. H. Ôkubo. *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 430–435, *Dec.,* 1934. *In English.*—Stresses in a prismatic cylinder of ⊂ section are determined by the method of conformal representation developed by Trefftz. [*Math. Annal.* 82. 1921.] J. S. G. T.

574. Young's Modulus of Refractories of Varying Silica Content. R. A. Heindl and W. L. Pendergast. *Bureau of Standards, J. of Research,* 13. *pp.* 851–862, *Dec.,* 1934.—Determinations of Young's modulus of elasticity of 10 brands of fire-clay bricks (ranging in silica content from 48 to 52 %), 2 brands of silica bricks, and an 80 % alumina fire brick, were made at room-temperature, 100, 200, 400, 500, 600, and 800° C. In a few cases determinations were made also at 300, 700, and 900° C. Six samples were tested through temperature regions of crystalline silica inversions at intervals of less than 100° C. The data show that the modulus of elasticity is affected greatly by the total silica content, modified by the form of the crystalline silica present and by the temperature. A general relation was found between modulus of elasticity, total silica, and linear thermal expansion. AUTHORS.

575. Compressibilities and Apparent Volumes of Salts in Solution. A. F. Scott and R. W. Wilson. *J. Phys. Chem.* 38. *pp.* 951–977, *Oct.,* 1934.—An analysis of results previously described [see Abstract 83 (1935)]. Masson's equation, $\phi = kc^{\frac{1}{2}} - \phi_0$, is shown to be applicable to these results (ϕ is the apparent molal volume of solute at concentration c) and relationships are derived between (1) c and $d\phi/dp$ ("apparent molal compressibility" of solute) and (2) c and the compressibility coefficient, β, of the solution. The significance of the variation of the apparent compressibility with the apparent volume is considered from the standpoint of the contraction of the solvent due to the solute and the volume of the solute in solution is calculated on the assumption that the limit of the solution state is reached when the compressibility coefficient of the solute in solution equals that of the crystalline salt; these calculated volumes are shown to be of the expected order of magnitude and to be additive. The conclusion is reached that the kations (Na^+, K^+) produce the same or no contraction of solvent while the anions cause a contraction which decreases in the sequence Cl^-, Br^-, I^-. The applicability of Gilbault's equation to these data is discussed. L. V. C.

576. Compressibility of Solutions of Three Amino-Acids. P. W. Bridgman and R. B. Dow. *J. Chem. Phys.* 3. *pp.* 35–41, *Jan.,* 1935.—The compressibility of aqueous solutions of glycine, α-amino-butyric acid, and ε-amino-caproic acid have been measured over the concentration range up to 2·5 *N* at 25° and 75° C. and up to a maximum pressure of 8000 kg./cm.^{2} The results are exhibited in tables giving the volume in cm.^{3} as a function of pressure, temperature, and concentration of that amount of solution which contains 1 gm. of water, and in figures showing the apparent molal volume at 25° as a function of pressure and concentration. The general character of the results is complicated; the most striking result is that at low pressures the apparent compressibility of the acid in solution is positive, which is opposite in sign from all other known solutes. A connection is probable with the high dielectric constant. Other qualitative aspects of the phenomena are discussed. AUTHORS.

577. Variation of Rigidity of Nickel with Magnetisation. R. Jouaust. *Comptes Rendus,* 199. *pp.* 1195–1196, *Nov.* 26, 1934.—From observations of the period of a torsion pendulum of which the nickel wire suspension in one case hangs free inside a magnetising solenoid, and in another case is also maintained in vibration and synchronised by a periodic current along the wire, it is found that for fields between 15 and 70 gauss the rigidity modulus of nickel decreases by about 2 %. This result is in agreement with previous work [see Abstract 2103 (1905)]. G. E. A.

578. Photoelastic Properties of Soft, Vulcanised Rubber. W. E. Thibodeau and A. T. McPherson. *Bureau of Standards, J. of Research,* 13. *pp.* 887–896, *Dec.,* 1934.—This paper refers to a study of double-refraction under tensile stress made on transparent, vulcanised rubber of different compositions at about 25° C. by means of a Babinet compensator, using light of wave-length 5461 Å. Measurements have been made over relatively wide ranges of stress and composition, and indicate that for any given rubber compound the relation between relative retardation per unit thickness and stress can be expressed by a simple equation. The relation with organic accelerators for certain compounds may be expressed as a linear one, while for rubber-sulphur compounds the relation is a function of the combined sulphur content. J. K.

See also Abstracts 559, 694, 793.

GRAVITATION.

579. Gravitational Theory. A. Levašov. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 124–129, *Oct.* 21, 1934. *In German.*—In a previous publication [see Abstract 118 (1935)] on the relativisation of classical mechanics, the theory of the geometry of the space-time complex was developed. In this paper the rigid solution of the gravitational problem is considered and its physical consequences are investigated The results are applied to the theory of the perihelion motion of Mercury. H. H. Ho.

580. Elevation of the Geoid in the Harz and Central Europe. K. Mader. *Gerlands Beitr. z. Geophys.* 43. 1–2. *pp.* 134–155, 1934.—Calculations do not favour isostatic adjustment in the Harz. Definite conclusions as to non-compensation in Central Europe are not possible, because the results of the astronomical levelling depend too much on the deviation of the vertical at the initial station. W. A. R.

HYDRODYNAMICS AND AERODYNAMICS.

581. Ground Effect in Wind Tests on Vehicle Models. R. H. Heald. *Bureau of Standards, J. of Research,* 13. *pp.* 863–870, *Dec.,* 1934. —In order to simulate full-scale conditions when vehicle models are tested in the wind tunnel it is necessary to represent the presence of the ground. Approximate representation of ground effect can be obtained by means of either the fixed ground-plane method or the image method. An experimental comparison of the two methods, in which concordant results were obtained, is described and the results are discussed from the viewpoint of present knowledge of air flow. AUTHOR.

582. Air Forces and Yawing Moments for Automobile Models. R. H. Heald. *Bureau of Standards, J. of Research,* 13. *pp.* 871–878, *Dec.,* 1934.—The lift, drag, cross-wind force, and yawing moment for three models representing automobiles having substantially different body shapes were measured in the wind tunnel. Measurements were made for relative wind angles, in the horizontal plane, between 0° and 180°. The results of the model investigation, extrapolated to full scale, indicate the presence of rather large lift, lateral force, and yawing moment under certain conditions of car speed and natural wind speed. AUTHOR.

583. Disturbance of the Steady Flow of an Inviscid Liquid between Parallel Planes. J. L. Synge. *Roy. Soc., Phil. Trans.* 234. *pp.* 43–78, *Dec.* 31, 1934.—Rayleigh's characteristic value method for the discussion of the stability of fluid motion is considered. It is shown that the criteria for the stability of the flow of an inviscid liquid between parallel walls given by Rayleigh cannot be legitimately deduced by his method. The method of vorticity, also suggested by Rayleigh, is applied to the same problem, and it is shown that the distribution of vorticity determines the distribution of velocity with a slight degree of indeterminacy. A method is outlined for the determination of the effect of a finite disturbance by a process of successive approximations involving integro-differential equations. The argument is confined to the first approximation, the vorticity being developed as a Fourier series. The parabolic velocity profile only is discussed. It is suggested that for the disturbance of a viscous fluid, the vorticity method may be more valid than that of characteristic values. G. F. P. T.

584. Wave Rings on a Fluid Surface. H. Widenbauer. *Zeits. f. angew. Math. u. Mechanik,* 14. *pp.* 321–332, *Dec.,* 1934.—The surface waves formed when a circular cylindrical stone is dropped into deep water, which is originally at rest, are discussed, with a certain restriction on the radius r and the time t. From the usual hydrodynamical equations it is deduced by means of Fourier integrals that a solitary disturbance is caused for the $t = 0$. The integrations are carried out by an exact method (the saddle point method), as has been done for similar wave problems. Bessel functions are used in the development. The form of the surface is considered when the radius of the disturbance approaches zero, which is the case usually investigated. The form of the surface caused by a disturbance of finite radius is given detailed consideration. G. F. P. T.

585. Forces on an Elliptic Cylinder, Moving Through an Ideal Fluid. A. Ratib. *Zeits. f. angew. Math. u. Mechanik,* 14. *pp.* 340–342, *Dec.,* 1934.—The two-dimensional motion of an elliptic cylinder in an incompressible ideal fluid is discussed. The cylinder rotates about a point in its major axis, the point itself having a uniform velocity in a straight line. The stream and potential functions for the motion are introduced and expressions are found for the forces, moment and circulation about the cylinder, by means of two methods, one in which the circulation is zero, and the other involving Bernouille's pressure equation. The paper is entirely mathematical. G. F. P. T.

586. Experimental Investigation of Potential Motion. W. Barth. *Zeits. f. angew. Math. u. Mechanik,* 14. *pp.* 347–348, *Dec.,* 1934.—When attempts are made to investigate exactly problems of potential motion insurmountable difficulties are often met with. An experimental

method of determining potential motion is described. For the motion through stratified matter it is shown that the motion is potential motion and that the equi-potential surfaces are surfaces of equal pressure. This result is used to determine the potential motion by measurement of the pressure in the matter under discussion. The stream motion in a smelting furnace is investigated by this method. The base of the furnace, which is taken to be a surface of revolution, is divided up into a number of triangular segments. Holes are made at various places in each segment and the pressure is measured when air is sent through the furnace.
G. F. P. T.

587. Class of Natural Movements of Viscous Fluids, Characterised by a Minimum Force of Dissipation ; Case of the Sun. G. Dedebant, P. Schereschewsky and P. Wehrlé. *Comptes Rendus*, 199. *pp*. 1287–1289, *Dec*. 3, 1934.—The property of minimum dissipation of energy is a fundamental characteristic of the motion of a viscous fluid. This principle is used to find the theoretical law of rotation of the sun. The assumption is made that the sun is a fluid mass, rotating about an axis of revolution, and that the turbulent dissipation is a minimum with regard to all movements on the surface of the star. It is shown that this law represents spectroscopic measurements to within 1 in 200, which is an improvement on the law of Faye. G. F. P. T.

588. Flow Forms in a Channel of Small Exponential Divergence. G. N. Patterson. *Canad. J. of Research*, 11. *pp*. 770–779, *Dec*., 1934.—The motion of air through a channel of small exponential divergence has been investigated experimentally. A flow form derived by Blasius from theoretical considerations has been shown to exist in the range $25 < R < 36$ for the Reynolds number. The dependence of the general flow form on the initial velocity distribution where the divergence begins has been studied. It has been found that when this initial velocity distribution is parabolic, indicating a laminar motion in the throat of the channel, the flow form is symmetrical. Further investigations have shown that when the initial velocity distribution indicates that the motion near the walls in the throat of the channel lies in the transitional region between a laminar and a turbulent flow, then the flow form is unsymmetrical. Empirical equations have been obtained which give (1) the initial velocity distribution in the transitional region at $R = 75 \cdot 1$, and (2) the motion near the walls where the divergence begins for Reynolds numbers lying in the range $0 < R < 75 \cdot 1$.
AUTHOR.

***589. Reaction Trumpet. J. Chalom.** *Comptes Rendus*, 199. *pp*. 1289–1291, *Dec*. 3, 1934.—The reaction trumpet causes the reaction effect of a propulsive jet to be increased. The trumpet can be made of one or several tubes. An attempt is made to determine the best shape for the tubes and to establish the laws giving the properties of the propulsive apparatus composed of the mouth and the horn. G. F. P. T.

590. Uniformity of Pressure in Fluids Subject to Great Accelerations. J. Villey. *Comptes Rendus*, 199. *pp*. 1291–1293, *Dec*. 3, 1934.—An attempt is made to determine under what experimental conditions pressure will no longer exist at a point in a rapidly flowing permanent gas following the curved trajectories, the density meanwhile remaining, however, sufficient to maintain the idea of stable pressure on a small surface corresponding to possible measuremeuts. For this state to appear, it is necessary to show that the classical argument of the vanishing tetrahedron is no longer true, as d'Alembert's force of inertia would not then be negligible with regard to the pressure forces on the faces of the tetrahedron, at the moment when the latter becomes too small to still contain the great number of molecules necessary to give the same conception for the pressure. G. F. P. T.

See also Abstracts 546, 594, 618, 643, 644, 647, 650, 726.

KINETIC THEORY OF MATTER.

591. Linear Problems in Brownian Movement. Part III. G. Krutkow. *Comptes Rendus de l'Acad. des Sciences U.S.S.R.*, 4. *pp.* 120–124, *Oct.* 21, 1934. *In German.*—In the former parts of this investigation [see Abstract 4430 (1934)], the simplest example of the linear vibrator was considered wherein besides the forces $-n^2x$ and $-2hx$ there also acts the force $Q(t) - De^{ikt}$. The present paper contains a generalisation for $Q(t)$, a study of the case of free particles, and a derivation of the distribution functions. The paper is entirely mathematical. H. H. Ho.

See also Abstracts 614, 796.

LENGTH (STANDARDS, MEASUREMENTS, APPARATUS).

***592. Calibrations of Line Standards of Length of the National Bureau of Standards. L. V. Judson and B. L. Page.** *Bureau of Standards, J. of Research*, 13. *pp.* 757–772, *Dec.*, 1934.—The results of the intercomparison of total lengths of metre and of decimetre bars, and the results of calibrations of sub-intervals of several of them are given in considerable detail. The precision of the results is discussed. That the basis of length measurements in the United States (Prototype Metre 27) has remained unaltered to about 1 part in 10,000,000 for over 40 years is pointed out, and the wisdom of the conclusions stated by L. A. Fischer in the first scientific paper published by the Bureau of Standards is shown. AUTHORS.

MATHEMATICAL METHODS, THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

593. Calculation of Numerical Tables. Briggs-Mouton Functions. F. Emde. *Zeits. f. angew. Math. u. Mechanik*, 14. *pp.* 333–339, *Dec.*, 1934.—This paper deals with methods of computation and considers the various processes developed by Lagrange, Briggs and Mouton, Comrie and others. H. H. Ho.

594. Toroidal Functions and the Complete Elliptic Integrals. J. R. Airey. *Phil. Mag.* 19. *pp.* 177–188, *Jan.*, 1935.—The desirability of tabulating toroidal functions for half odd integral numbers has often been emphasised. These functions satisfy Laplace's equation and are suitable for conditions over the surfaces of anchor rings. The tesserol toroidal functions $y = P_{m,n}(u)$, n the order and m the rank satisfy the differential equation,

$$\frac{d^2y}{du^2} + \coth u \frac{dy}{du} - \left\{ (n^2 - \tfrac{1}{4}) + \frac{m}{\sinh^2 u} \right\} y = 0.$$

A more convenient and accurate way than that of tabulating by means of hypergeometric functions is suggested through the medium of the complete elliptic integrals of the first and second kinds, tables of which are given to ten decimal places. The formulæ due to Legendre are used in computing the tables, the range of argument for the first kind being 0·830 to 1·000 and for the second kind 0·900 to 1·000. G. F. P. T.

595. Optical Analysis of Non-Periodic Curves. M. Lévy. *Comptes Rendus*, 199. *pp.* 1031–1033, *Nov.* 12, 1934.—Madelung's process of harmonic analysis, as described by Germanski [see Abstract 1184 (1931)] is generalised so as to apply to the optical analysis of non-periodic curves, and so obtain in a single operation the spectrum of intensities of any given curve. C. A. S.

***596. Harmonic Analyser. J. Harvey.** *Engineering*, 138. *pp.* 667–669, *Dec.* 21, 1934.—Describes and gives the theory of an instrument independent of a planimeter and based on a rediscovery of Yule's principle (*Phil. Mag., April*, 1895), by which the harmonic analysis of a function can be effected. The instrument is adapted for finding area and the first and second moments of area about an axis. P. H. B.

See also Abstracts 597, 598.

MECHANICS, CLASSICAL.

597. Special Markoff Series on the Galton Board. H. Münzner. *Zeits. f. angew. Math. u. Mechanik*, 14. *pp.* 343–346, *Dec.*, 1934.—The author describes the use of the Galton board for solving a problem in the calculus of probability, and includes data showing excellent agreement between theory and experiment where the processes concerned can be expressed by a Markoff series. Full experimental details are given in the paper. H. H. Ho.

598. Theory of the Galton Board. G. Schulz. *Zeits. f. Physik*, 92. 11–12. *pp.* 747–754, *Dec.* 10, 1934.—The theory of the Galton board which indicates as probabilities for the left and right course of the ball at a nail, $q_0 = q_1 = \frac{1}{2}$, is not in agreement with observation, which for a large number of nail series shows an approximation to a Gauss distribution-curve, but with a scattering which is essentially greater than the anticipated value. The assumption of a symmetrical matrix of transition probabilities in the formula for the summation problem of the relevant Markoff chain gives a satisfactory statistical explanation of the observed phenomena. [See also Abstract 3539 (1934).] H. H. Ho.

See also Abstract 895.

MECHANICS, QUANTUM.

599. Wave Theory of Neutrinos. G. Rumer. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 21–24, *Oct.* 11, 1934. *In German.*—A general wave theory of neutral massless particles possessing only energy and momentum is formulated. Photons and neutrinos are shown to fall within the scope of this theory. J. E. R. C.

600. Quantum Conditions and Schrödinger's Equation. A. Alexandrov. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 198–202, *Nov.* 1, 1934. *In English.*—It is proved that the quantum conditions and Schrödinger's equation follow, for the average values of coordinates and the gradient of potential energy, from the general principles of quantum mechanics and the second law of Newton. N. M. B.

601. Electromagnetic Fields and the Quantum Theory. Part II. L. Goldstein. *J. de Physique et le Radium*, 5. *pp.* 623–627, *Dec.*, 1934.—A continuation of work previously reported [see Abstract 112 (1935)]. The static electromagnetic field associated with the discrete stationary states of hydrogen-type atoms is investigated relativistically. The potentials from which the fields are derived, and the expression for the scalar potential differ little in form from the corresponding magnitudes (potential and vector potential) in the previous treatment. The vector potential existing in the relativistic theory for all the states cannot be obtained in a finite form, showing that the relativistic current density gives place to a static magnetic field. N. M. B.

602. Electrodynamics of Quantum Theory. V. Fock. *Phys. Zeits. d. Sowjetunion,* 6. 5. *pp.* 425–469, 1934. *In German.*—A simplification of the mathematics used in the theory of the quantised electromagnetic field is worked out. In the case of the Bose statistics the wave-functions are expressed as infinite series of multiple integrals. The electrodynamics of a vacuum and the interaction of matter and radiation are also dealt with. As examples, some formulæ such as the Breit-Moller interaction formula, and the natural line-breadth formula, are derived to illustrate the applicability of the mathematical technique. G. C. McV.

603. Numerical Solution of Generalised Equations of the Self-Consistent Field. V. Fock and Mary J. Petrashen. *Phys. Zeits. d. Sowjetunion,* 6. 3. *pp.* 368–414, 1934. *In English.*—A method of numerical solution of the generalised equations of the self-consistent field, taking into account Pauli's exclusion principle, is developed, and the results applied to determine term values, core-electron wave functions, X-ray terms, screening potentials and energies of the sodium atom. J. S. G. T.

604. Wave Mechanical Treatment of the Molecule Li_2^+. H. M. James. *J. Chem. Phys.* 3. *pp.* 9–14, *Jan.,* 1935.—The Li_2^+ molecule has been treated by methods previously applied to the study of Li_2 [see Abstract 4880 (1934)]. It appears that the dissociation energy of Li_2^+ must be greater than that of Li_2, and is probably $1\cdot30 \pm 0\cdot05$ e.V. The ratio of one- to two-electron bond strengths appears to be greater with Li_2 than with H_2 because the bonding wave functions are more diffuse. The inner shells play a deterring rôle in the binding in Li_2^+ similar to that found in Li_2. The Heitler-London wave function has been compared with the much more accurate series function, and the general character of the satisfactory molecular orbital is noted. The form of the variational process used here appears to be particularly suitable for the treatment of one-electron bonds, and simple functions may be used to give highly satisfactory results, as illustrated by the cases of Li_2^+ and H_2^+. AUTHOR.

605. Wave Mechanics and Causality. F. v. Krbek. *Zeits. f. Physik,* 93. 1–2. *pp.* 123–124, *Dec.* 17, 1934.—The view is put forward that wave mechanics has no bearing on the question of causality. G. C. McV.

See also Abstracts 526, 677, 740, 772, 791, 879.

RELATIVITY AND ETHER.

606. Foundations of the Theory of Relativity, with Special Reference to the Theory of the Expanding Universe. W. de Sitter. *K. Akad. Amsterdam, Proc.* 37. 9. *pp.* 597–602, 1934.—It is pointed out that the theory of the expanding universe can be built up on the following four hypotheses (which also underlie the theory of relativity): (1) the laws of nature are expressible as equations between tensors in a four-dimensional, continuous and metrical manifold; (2) the tracks of material particles and photons are the geodesics of the manifold; (3) in the universe considered on a large scale there is in every region a definite mean motion which defines a cosmic time; (4) in a three-dimensional section of space-time every direction round a point is indistinguishable from every other. These hypotheses do not involve gravitation and, indeed, the expansion of the universe is independent of this phenomenon and depends only on the inertia of matter expressed in the above four axioms. G. C. McV.

See also Abstracts **579, 713, 894.**

SOLUTION.

607. Solubility of Sulphur Dioxide at Low Partial Pressures. Ionisation Constant and Heat of Ionisation of Sulphurous Acid. H. F. Johnstone and P. W. Leppla. *Am. Chem. Soc., J.* 56. *pp.* 2233–2238, *Nov.,* 1934.—The solubility of SO_2 in water is measured at 25°, 35° and 50° between 0·2 and 10·3 mm. The ionisation constants of H_2SO_3 are calculated from conductivity data. The free energy and heats of ionisation are calculated from the equilibrium constants. A. S. C. L.

608. Absorption Velocity of Gases by Liquids. Part IV. S. Hatta and A. Baba. *Tohoku Univ., Technol. Reports,* 11. 3. *pp.* 99–116, 1934. *In English.*—Measurements of the rate of absorption of CO_2 when bubbled through solutions of KOH. At higher temperatures the velocity increases for carbonate-rich solutions but decreases for bicarbonate-rich ones. The velocity decreases with increase of concentration of KOH owing to decreasing solubility of products causing reduction of diffusion rates. These are still further reduced by the increased viscosity of the more concentrated solutions. [For Parts II and III see Abstract 1352 (1933).] A. S. C. L.

See also Abstracts **549, 575, 877.**

SURFACE TENSION AND COHESION.

609. Antonov's Rule and Surface Tension of Solids. R. Loman and N. P. Zwikker. *Physica,* 1. *pp.* 1181–1201, *Dec.,* 1934. *In English.*—The validity of Antonov's rule for the solid-liquid interface is proved by the measurement of the contact angles ϕ_1 and ϕ_2 of water and mercury on smooth solid surfaces. The constancy of $\cos \frac{1}{2} \phi_1 / \cos \frac{1}{2} \phi_2$ required by the rule was found to hold within experimental error. By measurements with 46 solids the surface tension of mercury was indirectly found by this means to be 476 dynes/cm. with a probable error of 1·6 dynes/cm. The good agreement with published data justifies the application of Antonov's rule to the determination of the surface tensions of solids. The influence of preliminary treatment and cleaning on the surface tension of a solid is dealt with. P. H. B.

610. Surface Tensions of Ethyl Alcohol and Carbon Disulphide at Low Temperatures. T. Tonomura and (Miss) K. Ishihara. *Chem. Soc. Japan, Bull.* 9. *pp.* 439–441, *Oct.,* 1934. *In English.*—Measurements have been made of the surface tension of EtOH from 30° to −90° and of CS_2 from 20° to −42·39°. The curve of the EtOH results is quadratic and not of the Eötvös type. A. S. C. L.

611. Surface Tension of Aqueous Solutions of Sodium Salts of Fatty Acids. A. Lottermoser and B. Baumgürtel. *Kolloid-Beihefte,* 41. 1–3. *pp.* 73–94, 1934.—Surface tension (σ) measurements with a torsion balance, employing the pull on a ring, are described for solutions of sodium salts of 10 saturated fatty acids from formic to stearic and of oleic and abietic acid, covering a range of concentrations and temperatures. It is first shown that atmospheric CO_2, owing to hydrolysis of these salts (which does not occur with the sulphuric-esters of the corresponding acids), has a marked influence on σ, varying with time; the majority of the measurements were therefore made in a CO_2-free atmosphere in which, after the initial brief change from dynamic to static surface tension (which was measured), very steady values of σ were obtained. Full data for these acids and concentration and temperature ranges are given in graphical and tabular form. L. V. C.

612. Extension of Egg Albumen on Water. H. Devaux. *Comptes Rendus,* **199.** *pp.* 1352–1354, *Dec.* 10, 1934.—The previously observed irregularities in the extension of white of egg on water surfaces has been traced to variations in the pH value of the water in accordance with Coster's results. The thickness of a monomolecular film of egg albumen can vary with pH from 0·9 to 8 mμ. The CO_2 from the observer's breath can cause effective modification of the pH value. P. H. B.

See also Abstracts 522, 570, 676.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

***613. Time-Balance. G. Keinath.** *A.T.M.* 4. *T*149–150, *Nov.*, 1934.—Comments arising from experience gained in the use of the time-balance [see Abstracts 2361 and 2774 (1934)] for the rating of watches. P. H. B.

VACUA, HIGH.

***614. Low Pressure Measurement. W. Gaede.** *Zeits. f. techn. Physik,* **15.** 12. *pp.* 664–668, 1934.—Survey of the known methods of measuring low pressures leads to the design of a new vacuum gauge. The instrument consists of a glass container in which a piece of Al foil hangs from a quartz suspension. The container is indirectly heated in two opposite places and the radiometer effect produces on the Al foil a twist which is proportional to the pressure for very rarefied gases and vapours. The foil is electromagnetically deflected and the pressure is determined from the period of oscillation. The damping of the oscillations is directly proportional to the product of the pressure and the square root of the molecular velocity. For very low pressures, the statical deflection is compared with that produced by a known magnetic field. The range is from 10 to 10^{-7} mm. of Hg. F. C. C.

***615. High-Vacuum Cut-Off. G. W. Lobb and J. Bell.** *Journ. Sci. Instruments,* **12.** *pp.* 14–17, *Jan.*, 1935.—It is sometimes necessary to isolate the vessel being evacuated from the liquid-air trap. Experiments were carried out to find a liquid with a low vapour pressure (of the order of 10^{-8} mm. of Hg) which also has a low solubility for gases, and could thus be used in a cut-off. Various Hg amalgams gave good results. Na-Bi and Li-Bi amalgams gave vapour pressures of 5×10^{-8} mm. of Hg and proved satisfactory for sealing-off purposes. The Li-Bi amalgam should prove the most satisfactory, as Na, even when in an amalgam, is easily attacked by moist air. AUTHORS.

VISCOSITY, FRICTION AND LUBRICATION.

616. Rotary and Translatory Viscosity. J. L. Snoek. *Phys. Zeits.* 35. *pp.* 911–914, *Nov.* 15, 1934.—The ratio of the viscosity of solutions of polar substances in CCl_4 and benzene to that of the pure solvent is measured. By considering the Einstein equation for the viscosity of suspensions, solvation is assumed to take place ; this conclusion is supported by Debye's measurements on relaxation time [see Abstract 1303 (1934)], and shows a qualitative connection between " rotary " and " translatory " viscosity. Non-polar solutes, and the dependence of solvation on molecular moment are considered. W. R. A.

617. Viscosities of Liquid Oxygen, Nitrogen, Carbon Monoxide and Argon as Functions of Temperature. N. S. Rudenko and L. W. Schubnikow. *Phys. Zeits. d. Sowjetunion,* 6. 5. *pp.* 470–477, 1934. *In German.*—The viscosities of liquid O_2, N_2, CO and A were determined using three Ubellohde viscometers, one of which was calibrated with ethyl ether. *Results* : O_2, η varies from 0·00873 cp. at 54·4° Abs. to 0·00190 cp. at 90·1° Abs. ; N_2, from 0·00292 at 63·9° Abs. to 0·00158 at 77·3° Abs. ; CO, from 0·00287 at 68·5° Abs. to 0·00170 at 80·9° Abs. ; A, from 0·00280 at 84·2° Abs. to 0·00252 at 87·3° Abs. Wahl's finding that liquid oxygen has a high viscosity at its triple-point, 54·5° Abs. [see Abstract 1071 (1913)] is attributed to supercooling phenomena. L. V. C.

***618. Conicylindrical Viscometer. M. Mooney and R. H. Ewart.** *Physics,* 5. *pp.* 350–354, *Nov.*, 1934.—A new rotating cylinder viscometer is described in which, to overcome the inconvenience of guard-rings, the bottom surfaces of the two cylinders are cones of slightly different angle, the bottom of the outer cylinder being actually flat in the instrument used. The hydrodynamical theory of the conical region is developed and a formula is given for the proper angular separation of the conical surfaces to produce the same rate of shear between the cones as between the cylindrical sides. The theoretical relation between viscosity, applied torque and rate of rotation is checked experimentally by measurements with glycerin solutions of known viscosities (0·2–5·0 poises). L. V. C.

ASTRONOMY AND ASTROPHYSICS.

COSMOGONY.

619. Stability of Cosmological Models. N. R. Sen. *Zeits. f. Astrophysik,* 9. *pp.* 215–224, *Dec.* 3, 1934. *In English.*—The conditions of instability of the cosmological models of the Einstein static universe and the Friedmann non-static universe are discussed [see Abstract 2370 (1934)]. J. S. G. T.

620. Philosophical Problem of the Existence of the Physical World. V. F. Lenzen. *Am. Phys. Teacher,* 2. *pp.* 152–158, *Dec.,* 1934.—The meaning of the existence of the physical world is discussed in three stages. In the first stage the empirical significance of physical concepts is explained by exhibiting the phenomena and principles upon which physical concepts are based. The transition from a perceptual to a constructive level is especially noted. The contemporary theory of logical positivism would not go beyond such a theory of scientific method. The author, however, assumes the significance of theory of knowledge as a second stage, and especially considers dualism and phenomenalism. The acceptance of dualism in the seventeenth century set problems for speculative metaphysics. The principal modern philosophical discussions of dualism are set forth. AUTHOR.

See also Abstract 606.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

621. Stellar Case of the Problem of Three Bodies with Application to the Algol System. R. A. Lyttleton. *Roy. Astron. Soc., M.N.* 95. *pp.* 42–55, *Nov.,* 1934.—The changes of period, determined from their light curves, of close binary systems disturbed by a third distant star are investigated. The problem presents similarities to the lunar problem but the ratio of the mean distances is larger. The solution of the theoretical problem is used to elucidate the observations of the Algol system. G. C. McV.

LATITUDE AND LONGITUDE.

622. Latitude Observations at Greenwich. S. Kawasaki. *Roy. Astron. Soc., M.N.* 95. *pp.* 33–41, *Nov.,* 1934.—An investigation of the effect of the direction of the wind on the latitude observations made at Greenwich was carried out by using the observations made during the years 1919·6 to 1927·1. More than half of the Kimura term in the latitude observations was shown to be due to the wind. It is also to be expected that in all meridian observations at Greenwich a systematic term of semi-annual type will be found. G. C. McV.

NEBULÆ.

623. Excitation of the Nebular Line 4267 (c) in Oxygen. H. Nagaoka and T. Futagami. *Imp. Acad. Tokyo, Proc.* 10. *pp.* 554–556, *Nov.,* 1934. *In English.*—Experiments were performed to show that this line is enhanced in an atmosphere of oxygen when a minute quantity of carbon is present. G. C. McV.

624. Intensity Distribution in Spectrum Lines of Orion Nebula. Part II. R. Minkowski. *Zeits. f. Astrophysik*, 9. *pp.* 202–214, *Dec.* 3, 1934.—In continuation of previous work [see Abstract 3968 (1933)], the relative intensity of N1 and N2 is found to be constant, but that of Hα to Hβ and of Hβ to N1 varies in different parts of the nebula. Some tentative measures of the relative widths of Hα and Hβ indicate that the difference between them is at least not greater than is to be expected, if due to Doppler effect. M. A. E.

625. Spectrum and Composition of the Gaseous Nebulæ. I. S. Bowen. *Astrophys. J.* 81. *pp.* 1–16, *Jan.*, 1935.—The primary source of nebular luminosity is the emission of radiation on the return of electrons after ionisation by extreme ultra-violet starlight. Additional luminosity is produced by the following secondary mechanisms: (1) Ionisation by secondary radiation.—Additional atoms are ionised by extreme ultra-violet quanta emitted by the primary mechanism. (2) Excitation by secondary radiation.—Line absorption of secondary quanta may excite an atom of the same kind as the primary emitting atom, or any other atom that has absorption lines which coincide with lines of the emitting atom. This mechanism, made possible by certain chance coincidences between lines of He II, O III, and N III, explains the presence with a high intensity of a selected group of O III and N III lines while all other lines of these elements are missing. (3) Excitation by secondary electrons ejected by the primary mechanism.—This is practically the sole source of excitation of the forbidden lines. A study of nebular line intensities in the light of the foregoing processes indicates that H is the most abundant element and He is the second. N, O, Ne, S—and possibly C and A—are present but are very much rarer. The lines of these heavier elements are strong, not because the elements are very abundant but because they are able to make use of large sources of energy that are not available to the predominant H and He. Lines of F, Na, Si, P, Cl, K, and Ca are missing. AUTHOR.

PLANETS.

626. Lunar Radiation as Related to Phase. E. Pettit. *Mt. Wilson Observat. Contrib. No.* 504. *Astrophys. J.* 81. *pp.* 17–36, *Jan.*, 1935. —An image of the moon, 0·87 mm. maximum dia., was formed by a concave mirror of 6·4 cm. aperture and 8·8 cm. focal length alternately upon the two receivers of a vacuum thermocouple. The planetary heat was separated from the light by a microscope cover-glass. The apparatus was calibrated by a standard lamp at 71·3 m. distance. An air-mass meter was devised to read secZ directly. The measurements were reduced to the zenith with the atmospheric extinction observed for the night or, when only one or two observations were made, by using the mean extinctions, 0·11 mag. for reflected light and 0·15 mag. for planetary heat. Small corrections were applied for the planetary heat transmitted, and light reflected, by the microscope cover-glass screen, and the measurements were then reduced to mean distance of sun and moon. The mean curves were corrected to no atmosphere for comparison with the theoretical formula. The radiometric magnitude of planetary heat per square second of arc for temperatures between 140° and 500° K. is given by the empirical equation

$m'_r + \Delta m'_r = (1545/T) - 2\cdot6$. The radiometric magnitude of the planetary heat from the full moon under normal conditions is − 14·8, and that of the reflected light, − 13·4. The measurements of planetary heat made by the Earl of Rosse are 10–20 per cent lower than the present values for most phases of the moon, and lower still for reflected light, although the uncertainty of the corrections which should be applied makes the comparison difficult. No great amount of asymmetry such as has been reported by others was observed in the phase-intensity curve. The theoretical curve is everywhere higher than the observed curve. The transmission of an equivalent of 2 cm. of ozone measured for the differential radiation between boiling water and liquid air was 0·92, which indicates that atmospheric ozone absorbs 4 per cent of the planetary heat from the moon. AUTHOR.

627. Lunar Ray Craters. S. G. Hacker and J. Q. Stewart. *Astrophys. J.* 81. *pp.* 37–44, *Jan.*, 1935.—A short bibliography and résumé of various suggestions concerning the formation of lunar rays are given. The suggestion that the rays were formed by ejection from the associated craters is examined quantitatively, and some aspects of the possible mode of formation are discussed. It is found that the minimum initial velocity required to produce the longest ray from Tycho is 1 km./sec., taking into account the moon's curvature. A "typical ray crater" has a (1) bright centre floor, (2) dark annulus, (3) bright nimbus, (4) ray system. Assuming the projection to have taken place in the most efficient manner, the energy required to form the various features of Tycho is calculated. These energies are found to furnish no criterion of distinction between the volcanic and the meteoritic suggestions of formation of these craters, but are probably compatible with both. An equal-area map of the moon shows the distribution of ray- and light-surrounded craters listed by Elger. The distribution is analysed by octants. There is a decided tendency for these craters to appear on the maria, probably owing to their better visibility there by reason of the contrast with the dark background. There is, however, no tendency toward grouping on the maria as between one octant and another. Similarly, the distribution off the maria is also random. The randomness of distribution favours the suggestion that the ray craters are of meteoritic origin. AUTHORS.

STARS.

628. Significance of Right-Ascension Errors in Trigonometric Parallaxes. T. E. Sterne. *Astrophys. J.* 81. *pp.* 45–65, *Jan.*, 1935.—The significance of the data by van Maanen [see Abstract 5206 (1933)] relating to systematic errors, depending upon right ascension, in the trigonometric parallaxes of eight observatories, is examined by improved statistical methods. There is good evidence, from the harmonic analysis, for the existence of systematic differences, of period 24^h in right ascension, between trigonometric parallaxes determined at the Allegheny and the McCormick Observatories. The variation with right ascension cannot reasonably be attributed, entirely, to fluctuations of sampling. There is no evidence, from either the harmonic analysis or the tests for homogeneity, of any systematic variation with right ascension, of the hourly mean differences between spectroscopic parallaxes and trigonometric parallaxes determined at any of the following observatories: Mt. Wilson (60-in.), McCormick, Yerkes, Greenwich. A systematic error depending upon right ascension is suggested in the trigonometric parallaxes determined at the Allegheny Observatory. The errors, if present, are probably of period 24^h in right ascension. Systematic errors of period 24^h in right ascension are strongly suggested in the differences between the spectroscopic and the trigonometric parallaxes determined at the Sproul and the Yale (photographic) Observatories, both by tests for homogeneity and by harmonic analysis. There is some evidence for the existence of a systematic variation, of period 6^h or less in the right ascension (but not necessarily exactly periodic), in the differences between the Cape photographic and spectroscopic parallaxes (the variations of longer period can be attributed to fluctuations of sampling). The point is not stressed, despite a strong indication of inhomogeneity, because of the inherent implausibility of such short-period variations. There is no evidence for the existence of systematic error depending upon right ascension, in the spectroscopic parallaxes used in the comparisons. Hence the right-ascension errors, in the few cases mentioned above where they are probably present, are most probably in the trigonometric parallaxes. AUTHOR.

629. Stellar Parallaxes Determined at the Royal Observatory, Greenwich. *Roy. Astron. Soc., M.N.* 95. *pp.* 67–69, *Nov.*, 1934.

630. Stellar Parallaxes Determined Photographically at the Royal Observatory, Cape of Good Hope (Sixth List). *Roy. Astron. Soc., M.N.* 95. *pp.* 70–76, *Nov.*, 1934.—A continuation of previous lists [see Abstract 1010 (1934)].

631. Apparent Displacements of Pole Star. J. Xanthakis. *Bull. Astronomique*, 8. 8*pp.* 463–472, 1933.—A continuation of Esclangon's work [see Abstract 2421 (1929)] by the addition of observations in the years 1930–33. Successive transits of Polaris should eliminate systematic errors of R.A. and leave only accidentals, but this is not so, since Polaris transits may occur at all hours of the day; the 1930–33 curve and Esclangon's are discordant, and the differences, $A_i - A_s$ (the line of sights of successive transits) form a sinusoid having its axis inclined and a period of about 21·5 yrs., differing from the orbital motion of Polaris; nor can it be explained by variation of latitude. A table and curves for 1931–33, give mean monthly azimuths of the line of sights from consecutive transits of Polaris and for circumpolar stars. The Polaris curve shows no temperature influence, but the two curves differ notably, and this must be due to systematic errors in the other circumpolars, or to diurnal variation in the azimuths, or to some unknown cause. A table of superior and inferior transits of 38 circumpolars and a diagram of the differences $A\alpha_s - A\alpha_i$ for 1931–33 shows a 6-month periodic variation, changing sign at the equinoxes, and in 1933 changing phase indicating that there are systematic errors in the R.A. of circumpolars generally, and the author urges a revision of the 50 circumpolar stars used to obtain Bessel's constants. A. S. D. M.

632. Axial Rotation and Stellar Temperatures. E. A. Kreiken. *Zeits. f. Astrophysik*, 9. *pp.* 225–238, *Dec.* 3, 1934. *In English.*—The periods of orbital revolution of the spectroscopic binaries are computed from the formula: $\log P = 1^1/_2 \log {}^1/_2 D - {}^1/_2 \log \mathfrak{M} + 0{\cdot}45$. [See Abstract 3761 (1931)]. Considering the individual deviations $(\log P)_0 - (\log P)_c$ it appears that within each spectral type these differences systematically depend on the absolute magnitude. From these residuals the values $\Delta (c_2/T)/\Delta M$ are computed. With the early spectral types the temperature increases towards the brighter stars. The possible influence of various errors is considered. AUTHOR.

633. Continuous Spectra of Bright Stars. W. Collmann. *Zeits. f. Astrophysik*, 9. *pp.* 185–197, *Dec.* 3, 1934.—A new attempt has been made to distinguish giant from dwarf stars by means of two-colour indices, the spectral regions being very carefully selected in the ultra-violet, blue, and infra-red, with their effective wave-lengths at 384, 455, and 725 $m\mu$. The result confirms that of Öpik, but does not improve upon it, and it is clear that the observational material is still too meagre, and the accuracy obtained insufficient, to decide whether a useful criterion for giants and dwarfs can be found by this means. M. A. E.

634. Spectrum of α Canis Minoris. W. Schaub. *Zeits. f. Astrophysik*, 9. *pp.* 198–201, *Dec.* 3, 1934.—From 12 spectrograms taken at the Yerkes Observatory, Albrecht has deduced a varying radial velocity for Procyon which implies the existence of a third member of the system and a period of 0·25 day with an amplitude of 12 km. This, however, must be a result of instrumental errors, and two long series of observations made at Bonn and the Cape are quoted to prove that no such period exists. M. A. E.

635. Statical Pressure and Density Law of the Stellar Atmosphere. K. Sotome. *Imp. Acad. Tokyo, Proc.* 10. *pp.* 550–553, *Nov.*, 1934. *In English.*—The author works out a substitute for the equation of hydrostatic equilibrium, $dP = -g\rho dr$, for a fluid with spherical symmetry, by taking the elementary cylinder from which the equation is derived so large that the curvature of the sphere of fluid has to be taken into account. G. C. McV.

636. Proper Motions of the Short-Period Cepheids. A. Fletcher. *Roy. Astron. Soc., M.N.* 95. *pp.* 56–60, *Nov.*, 1934.—A new investigation of the proper motions of these stars leads to the values $+0^{m}\cdot 69$ for the absolute magnitude from the peculiar motions and $+0^{m}\cdot 19$ from the parallaxes. Thus there is still considerable uncertainty as to the true zero-point of the period-luminosity curve. G. C. McV.

637. Spectra of Eclipsing Binaries. A. B. Wyse. *Lick Observat., Bull.* No. 464. *pp.* 37–51, 1934.—A study of 25 eclipsing binaries observed by the author, and of 28 observed spectroscopically by other people. The instruments, observational material and spectral classification are described, and tables are given, including columns for the spectra of the brighter (b.) and fainter (f.) components, the period, the ratios for b. and f. of the visual, and of the surface brightnesses, and the mean densities, with a diagram of the theoretical light curves and orbital models of WW *And*, RU *Cnc*, and RY *Gem*. The secondaries have an unexpected tendency to display bright hydrogen lines (5 out of the 25 observed by the author) and the hypothesis is discussed whether these are due to the b.-component flash spectra, but accounted improbable. In a table of spectra only 4 f.-components are earlier in type than the b.-, and 29 are later, but this is deemed due to observational selection. A diagram, relating period to difference of spectral type, appears to show that there is a marked division at $P = 2^{d}\cdot 5$, but an analysis of the ratio of surface brightnesses (Jb./Jf.) from 200 systems shows that no binaries with period less than half a day have differences of more than half a spectral class between the two components. Hypothetical and observed densities both show a wide range for every spectral group; early stars have the normal densities of their class, and several late have dwarfs, but there are many intermediates (especially among the secondaries) which have luminosities intermediate between dwarfs and giants. There are numerous disagreements in the ratios of surface brightness as derived from spectral types, and these are sometimes due to overlapping spectra, reflection effect, limb darkening, third body presence, etc.; but some discrepancies are real, though no reason for them can be given. A. S. D. M.

638. Spectrum of P Cygni. O. Struve. *Astrophys. J.* 81. *pp.* 66–96, *Jan.*, 1935.—Observational material and a table of 158 absorption lines are given. The spectrum of P Cygni (itself a nova in 1600) is compared with three normal stars (of types B_0, B_1, B_2) showing that it is not a normal B star, and that the enormous enhancement of its low-level lines must be due to other causes than thermal excitation; it resembles β Lyræ and 17 Leporis in some respects. The absorption lines originate in an expanding shell, and there is little difference here between absorption lines associated, or not, with emission lines; it may not be permissible to apply the ordinary theory of stellar absorption lines to such; nor the Boltzmann law of the number of atoms in various quantum states. The author discusses a strong line (in both absorption and emission) at λ/4396 as to its identification with OII 4395·95. He finds a fair degree of correlation between intensity and velocity; for any given element, strong lines have larger velocity of approach than faint ones; also there is correlation between velocity and ionisation potential; high excitation lines originate deeper inside the shell. He concludes that P Cygni is at about 1000 parsecs from the sun, with effective temperature 20000° K. Interstellar K-line is very strong, and interstellar absorption reduces the colour temperature to about 6000° K.; there is no line spectrum due to a stationary reversing layer; the lines (absorption and emission) originate in an expanding shell, accelerated outwards at about 200 km./sec. for the H-line region, and 50 km./sec. for the Si IV and N III regions [see Abstract 173 (1935)]. The mechanism of line excitation deviates from thermal excitation, and peculiar cases of fluorescence may be present. A. S. D. M.

See also Abstracts 621, 766.

SUN.

639. Solar Limb Effect. W. H. McCrea and K. K. Mitra. *Observatory*, 57. *pp.* 379–382, *Dec.*, 1934.—Assuming that the limb effect is due to an outward radial motion of the gases of the sun's atmosphere, the authors criticise the formula for the shift in wave-length, *viz.* $\Lambda = v_0\,(1 - \sqrt{(1 - x^2)})$; $(x = r/R)$, (where r is distance from centre of disc and R is the radius of the disc) on the ground that the velocity v_0 is not constant. The reason is that near the centre of the disc it is possible to see down to levels of lower velocity than at the edges, so that v_0 should decrease towards the centre. For a simple atmosphere of adiabatic type, the formula: $\Lambda = v_0\,(1 - (1 - x^2)^{(\gamma-1)/2\gamma})$ is obtained. With the value $\gamma = 5/3$ (monatomic gas) a closer agreement with observation is found than that obtained by using the earlier formula. G. C. McV.

640. Sun's Rotation Period from Recurrent Sunspots in the Period 1924–1933. H. W. Newton. *Roy. Astron. Soc., M.N.* 95. *pp.* 60–63, *Nov.*, 1934.—The diurnal motion of the sun calculated from the 130 recurrent sunspots of the cycle 1924–1933 is found to be $14°{\cdot}37 - 3°{\cdot}00 \sin^2\phi$, which is in good agreement with the results found from the four cycles 1878–1923. The consistent value of the a term found from the long-lived sunspots during these five cycles is also noteworthy. G. C. McV.

See also Abstracts 587, 679, 707.

GEOPHYSICS.

GEOPHYSICS, APPLIED.

641. Determination of the Depth of Horizontal Plates below the Earth's Surface from Torsion Balance Measurements. K. Mader. *Gerlands Beitr. z. Geophys.* 43. 1–2. *pp.* 156–184, 1934.—The depth of inclusions, such as plates lying horizontally and not of too great thickness, can be calculated from the curve of the gradient by means of the simple formulæ for the doubly infinite plate, with sufficient exactness for practical use. The shape of the plate is of little importance. The formulæ for the second derivatives of the potential are given for a finite, square, oblique plate ; for the finite vertical cylinder, and the finite wedge. W. A. R.

642. Seismic Prospecting. A. Graf. *A.T.M.* 4. *T*143–144, *Nov.*, 1934.—The principles of the determination of underground structure by artificial seismic disturbances are summarised. The reaction and the reflection methods with the required formulæ are given, together with illustrations of the field apparatus and seismograms. Seismic investigation is rather more costly than other geophysical modes of subsurface exploration. W. A. R.

HYDROSPHERE, PHYSICS OF THE

643. Oscillations of Water in a Fan-Shaped Basin. K. Hidaka. *Geophys. Mag., Tokyo,* 8. *pp.* 195–197, *Nov.*, 1934. *In English.*—The oscillations of water in a basin bounded by the arcs of two concentric circles and two diameters, and whose plan resembles a fan, are considered. Where the depth is a function of the radius the tidal motion is solved completely and some special cases are taken where the expressions for the oscillations can be simplified. R. S. R.

644. Oscillations of Water in Spindle-Shaped and Elliptic Basins and Associated Problems. K. Hidaka. *Geophys. Mag., Tokyo,* 8. *pp.* 199–202, *Nov.*, 1934. *In English.*—A list of corrections to the original paper [see Abstract 3294 (1931)].

645. Ocean Currents Produced by Winds. G. R. Goldsbrough. *Roy. Soc., Proc.* 148*A*. *pp.* 47–58, *Jan.* 1, 1935.—It has been shown by Ekman and Jeffreys that the effect of a steady wind upon a plane rotating sea is to produce a current in a direction inclined to that of the wind. Under certain conditions, the resultant drift of the water is perpendicular to the wind, but the surface current is inclined at an angle of 45° to the wind. A comparison of the prevailing winds and the corresponding surface currents at various points of the actual oceans has shown that the angle between the two varies considerably but in general it is less than 45°. There may be many causes for this difference between theory and observation ; the purpose of this paper is to examine the effect of the curvature of the earth. It is shown that under the same conditions as those assumed by Ekman and Jeffreys, the angle will not be 45° except in the polar regions, where the law is found to hold. A further result appears from the analysis.

The currents formed by winds which circulate in closed curves are themselves moving in similar closed curves, but the latter curves are displaced to the westward. An application is made to the motions of the waters in the North and South Atlantic oceans. AUTHOR.

See also Abstract 648.

LAND, PHYSICS OF THE

646. Earth Contraction and Mountain Building. Part II. E. M. Anderson. *Gerlands Beitr. z. Geophys.* 43. 1–2. *pp.* 1–18, 1934. *In English.*—The resistance of rock-masses to very long-continued pressures is at present unknown, and it cannot be tested in the laboratory. If the contraction-theory is true, the upper layers of the earth's crust must be able to resist a very large stress for millions of years, without being deformed beyond the elastic limit. These layers must, however, " creep " over a substratum which can only have about a thousandth part of the strength which exists above. This is a necessary inference, which appears to tell against the validity of the theory. [For Part I see Abstract 4101 (1934).] AUTHOR.

647. Hydrodynamical Investigation of the Sub-Soil Flow from Canal Beds by Means of Models. V. I. Vaidhianathan, H. R. Luthra and N. K. Bose. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 325–331, *Nov.*, 1934.—The application of hydrodynamics to the study of the effect of pumping and draining on the water-table in the sub-soil and the determination of the nature of percolation of water from canal beds is of importance, especially in places where irrigation is practised on a large scale. Two of the methods used to counteract the rise of the water-table are to pump out the sub-soil water and to adopt drainage systems. The first method has been found to be unsatisfactory. These investigations aim at studying the effect of the gradient of water-table in the sub-soil, and the effect of the flow from the bed of canals, and at testing how far the conclusions of theoretical hydrodynamics can be applied. The experiments are carried out in models. The photographs of stream lines in the sub-soil are shown. Qualitative agreements between theory and experiment are observed. G. F. P. T.

648. Movement of Strandlines. A. Penck. *Preuss. Akad. Wiss. Berlin, Ber.* 19. *pp.* 321–348, 1934.—A critical examination of all possible causes in the alteration of the relative level of sea and land—volcanic, tectonic, load and amount of ice capping, etc. Changes in the level of the sea itself, as distinct from the effects of movement of the land surface, are examined, and the effect on the size of uncovered land area may be considerable. W. A. R.

See also Abstracts 641, 654, 658, 659.

METEOROLOGY.

649. Subsidence within the Atmosphere. J. Namias. *Harvard Meteorolog. Studies No.* 2 [61 *pp.*], 1934.—After a brief introduction in which the method of representing the observational material is explained, the author divides his study into two main sections (*a*) a general discussion of subsidence and (*b*) illustrative synoptic material. After this follows a summary of the whole. In section (*a*) the effect of subsidence on the lapse-rate, the factors in the development of subsidence inversion, the connection between the horizontal divergence of air and the phenomenon of subsidence, the conservation of potential temperature and the observed variations in specific humidity along the surface of subsidence, are all fully discussed. Three synoptic situations, each extending over several days, are examined separately in section (*b*), and the results obtained set out in tabular form. From these tables numerous diagrams have been constructed to illustrate the text of section (*a*). Appended to the paper is a long series of charts showing the early morning surface pressure distribution on the days of observation together with lapse-rate diagrams and Rossby diagrams illustrating air movements obtained from the soundings. A. E. M. G.

650. Turbulent Motion in the Atmosphere. S. Sakuraba and I. Kimura. *Meteorolog. Soc., Japan, J.* 11. 8. *pp.* 357–382, 1933. *Geophys. Mag., Tokyo,* 8. *pp.* 125–151, *Nov.,* 1934. *In English.*—The author refers to Takaya's solution of the equation of eddy motion regarding the variation of the coefficient of eddy viscosity as a function of altitude and the conclusions he reached regarding its seasonal and diurnal variation. The fundamental equations are developed and their transformation to evaluate the coefficient of eddy viscosity but adopting Taylor's view regarding the linear increase or decrease of the coefficient with height. The growth of the eddy is found to be opposed to Takaya's views. A numerical value is obtained for the coefficient of virtual viscosity using Dobson's data and the variation of the development of eddies with seasonal and diurnal changes. A statistical examination is also made using Lindenberg data. Nisimura's formula for the variation of wind with height is discussed and considered unsound and the formulæ of Taylor, Guldberg and Mohn, Isimaru, Takaya and the authors are surveyed. R. S. R.

651. Pressure Rise by Stratospheric Cold Air Inflow without Participation by Tropospheric Processes. H. Thomas. *Preuss. Akad. Wiss. Berlin, Ber.* 17. *pp.* 222–236, 1934.—The views of Ficker, Palmen, Ertel and the Norwegian school regarding the influence of tropospheric air movements on stratospheric changes are first discussed. In this case registering balloon ascents at Lindenberg were used to show that the pressure increase of 35 mm. Hg at the ground was due to two stratospheric cold air inflows at heights between 9 and 15 km. The synoptic weather situation is described in detail. Rise of temperature occurred at lower levels and a fall from 9 to 15 km. Values of pressure and temperature for each 1 km. rise were calculated for the days 13th and 17th Jan. 1930, and give good agreement with the Lindenberg results. Ertel's method was also used and gives good agreement. The mechanism of the stratospheric pressure changes and the source of the energy are described. It is concluded that the changes were due to cold stratospheric air arriving between 9 and 15 km. and that adiabatic compression occurred in the lower levels with the development of the anticyclone. R. S. R.

652. Brightness of the Diurnal Sky and Scattering of Light in the Atmosphere. V. Fesenkov and E. Plaskovskaja. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 129–132, *Oct.* 21, 1934. *In English.*—The observations of the illumination of the diurnal sky were made in 1932 and 1933 with a visual photometer arranged for the purpose, and the measured brightnesses were compared at the beginning and end with a grey screen illuminated by the sun and some small portion of the sky around it. It was found that the brightness in every point of the sky may be represented as the product of two functions, one of which depends on the angular distance from the sun and the other on the equivalent thickness of the atmosphere. The representative curve of scattering is highly asymmetrical, being elongated in the direction of the incident ray, and the degree of asymmetry diminishes regularly with increased zenith distance of the sun. The latter may be correlated with the systematical rate of turbidity during the day. H. H. Ho.

653. Transparency of Air for Wood's Light. J. Duclaux. *Comptes Rendus,* 199. *pp.* 1328–1329, *Dec.* 3, 1934.—A peak distant 90 km. from Pic du Midi was photographed with light of wave-length 3682 Å. Normally at this wave-length the maximum distance of vision is 50–60 km. At the time the air was very dry with a relative humidity of 12 % and a temperature near to 0° C. and must have descended from the upper troposphere. The coefficient of absorption of the air with the sky as background is 23 % below the theoretical value. The theoretical value is considered to be defective and Götz's observations are used to support this view. It is concluded that atmospheric transparency results should be combined with those for ozone content for a knowledge of general atmospheric movements. R. S. R.

See also Abstract 726.

SEISMOLOGY.

654. Mathematical Treatment of Geotectonic Movements with Special Reference to the Undation Theory. R. W. van Bemmelen and H. P. Berlage. Jr. *Gerlands Beitr. z. Geophys.* 43. 1–2. *pp.* 19–55, 1934.—Mathematical treatment seems possible for vertical motions of the earth's surface (with one or more subsurface boundary layers) so far as crustal motions are due to the viscous flow of rocks. Application to the problem of the uplift of Scandinavia after its most recent glaciation proves the rationality of the interpretation of this uplift as the natural re-establishment of the disturbed equilibrium. Magmatic differentiation suffices to produce oscillations (or " undations "). Probably a tendency to isostatic equilibrium is sufficient to produce aperiodic oscillations only, whilst a tendency to hydrostatic equilibrium seems required to produce periodic oscillations. The theoretical frequency and damping ratio of these oscillations are, however, much too high. W. A. R.

655. Seismic Waves. Part I. B. Gutenberg and C. F. Richter. *Gerlands Beitr. z. Geophys.* 43. 1–2. *pp.* 56–133, 1934. *In English.*—Records of the Sumatra and Solomon Isles earthquakes of 1931 are subjected to detailed analysis. Travel times; S and P waves; diffracted, reflected, transformed waves reflected inside the core, and " unidentified phases " are all investigated. W. A. R.

656. New Type of Seismological Table for Distant Earthquakes. L. Bastings. *Gerlands Beitr. z. Geophys.* 43. 1–2. *pp.* 210–218, 1934. *In English.*—The table is based on European records of the New Zealand earthquake of 16 June, 1929, and gives for a point distant 165° from the epicentre the travel times, T, of 36 phases, including shear waves through the core, the differences in travel-time, τ, between each of these and each of the 12 phases most likely to be of use in epicentre determination, together with the values of $dT/d\Delta$ and $d\tau/d\Delta$, thus enabling T and τ to be evaluated for stations not far from 165° from the epicentre. The method is illustrated by recalculating Conrad's results for this earthquake [see Abstract 1771 (1930)], which were vitiated by misidentification of phases, and application to the record of the same earthquake obtained at Bidston, showing it capable of giving results accurate to about 1°. C. A. S.

657. Amplitude of P and S Waves of Deep Earthquakes. H. Honda. *Geophys. Mag., Tokyo,* 8. *pp.* 153–164, *Nov.,* 1934. *In English.*—The amplitudes and directions of motion at the earth's surface due to *P* and *S* waves, corrected for the inhomogeneity of the earth's crust and reflection at the earth's surface, have been calculated, and the results compared with those of observation at some score of stations in Japan in the earthquakes of 2 June, 1929, and 28 April, 1932. Fair agreement is shown. C. A. S.

658. ScS Waves and the Rigidity of the Earth's Core. H. Honda. *Geophys. Mag., Tokyo,* 8. *pp.* 165–177, *Nov.,* 1934. *In English.*—Methods are proposed for calculating the amplitude of the seismic motion at the earth's surface, due to the ScS waves, from the results of observations of the *P* waves made near the epicentres of deep earthquakes. Application to the deep earthquake in the Sea of Japan, 1932, seems to favour a liquid rather than a solid core. W. A. R.

659. Mechanism of Deep Earthquakes and Stress in Deep Layers of the Earth's Crust. H. Honda. *Geophys. Mag., Tokyo,* 8. *pp.* 179–185, *Nov.,* 1934. *In English.*—The arrangement of the principal stresses at the earthquake origin is discussed. Distribution maps of the Japanese area show that there are two great belts of deep earthquakes, and that these are approximately at right angles to each other. Investigation further indicates that shearing fractures under the influence of principal stresses arise at breakdown. W. A. R.

660. Travel Time of Earthquake Waves. K. Wadati and K. Masuda. *Geophys. Mag., Tokyo,* 8. *pp.* 187–194, *Nov.,* 1934. *In English.*—Reference is made to the difficulties in dealing with waves which enter the earth's crust so deeply as to attain the earth's core, since their velocity changes abruptly at the boundary surface of the core, and the Wiechert-Herglotz method cannot be applied to observed time-distance ($T - \Delta$) curves of the P^1 wave. The velocity of the P^1 wave in the core can be obtained from the $T - \Delta$ curve for the earth's core from observations of the ScPcS wave. The velocity obtained for the travel time of the PcPcP wave passing through the core along a diameter is shown graphically. This velocity is nearly equal to that obtained by Gutenberg, but more observations are required to obtain the reason for the differences. It gives a value of 7·5 km/sec. just inside the discontinuity surface, and a rapid increase with depth, but the latter is doubtful. The results may fail if the $T - \Delta$ curve used is not truly that of the ScPcS but another kind of wave. R. S. R.

***661. New Forms of Electromagnetic Seismographs. G. Grenet and J. Coulomb.** *Comptes Rendus,* 199. *pp.* 1439–1441, *Dec.* 10, 1934.—Reference is made to the results obtained for the general theory of seismographs with electromagnetic amplification [see Abstract 208 (1935)]. In this paper a study is made of the case where equality of periods is replaced by equality of loss, which does not lead to any modification of the characteristics of the apparatus. The cases immediately realisable, which are considered, are (1) false Galitzin, (2) false Wenner, and (3) apparatus with quasi-constant amplification. Numerical values illustrate the results. R. S. R.

See also Abstracts **642, 648.**

TERRESTRIAL ELECTRICITY AND MAGNETISM.

662. Decrease in Number of Ions in Air of Occupied Rooms. G. R. Wait. *J. Indust. Hygiene,* 16. *pp.* 147–159, *May,* 1934.—An experiment, carried out in a steel chamber occupied by seven people, shows a decrease in 1½ hr. in the small-ion content of the air. This is in agreement with all experiments on occupied rooms. There is a reciprocal relationship between large and small ions, thus by a given rate of production of nuclei (charged or uncharged) a limit is set to the number of small ions which can exist in the atmosphere. By experimenting on various rooms before and after occupation with an Aitken nuclei counter, it is found that the condensation nuclei increase. It is concluded that they are given off by the human body, and, although large rooms show greater increase than smaller ones, this may be due to not obtaining an average sample in the first case and to loss by impinging on the walls in the second. The results of these experiments agree well with the small-ion content in the steel chamber. H. M. B.

663. Impurities in Globular Lightning. E. Mathias. *Comptes Rendus,* 199. *pp.* 1083–1086, *Nov.* 19, 1934.—Globular lightning has been observed to pass on cooling quickly from a glowing white through a series of colours to red. This change in colour has formed the basis of at least two previous investigations. In the first of these it was concluded that the colour, red or yellow, indicated pure globular lightning, while a blue colour indicated the presence of an impurity. The author discusses these results and considers that the investigation demands another impurity such as iron, besides the blue source to account for the various colours observed. The pure globular lightning behaves as a black body, the other behaves differently. He also regards another method of approach to the problem possible through considering that pure globular lightning is almost without weight. Its stability depends then on the product of surface tension and area of globular surface. If an impurity, *e.g.*, iron, is present, the sphere breaks up into several. Impurity lowers the surface tension. These two methods are, in the author's opinion, complementary. A. E. M. G.

See also Abstracts 704, 705, 707, 846.

RADIOACTIVITY.

664. Ionisation Curves of α-Particles in Rare Gases. R. Naidu. *J. de Physique et le Radium*, 5. *pp.* 575–577, *Nov.*, 1934.—In previous papers [Abstracts 1961 and 3646 (1934)] the author has obtained the Bragg curves for Po α-particles traversing the rare gases. Using these results, and assuming proportionality between the loss of energy and the ionisation at any point on the path of the particle, the variation of velocity along the path is calculated. This enables the variation of the stopping power of the gas to be obtained. The velocities which correspond to the maxima of ionisation are evaluated.

J. E. R. C.

665. Absorption of α-Rays and H-Particles by Matter: Penetration and Retardation. G. Mano. *J. de Physique et le Radium*, 5. *pp.* 628–634, *Dec.*, 1934.—Theoretical and experimental data on the passage of heavy corpuscular rays through matter are compared. Recalculated values for the penetration in air of several natural groups of α-rays are in good agreement with experiment. The theory is extended to H-particles whose penetration in air is calculated as a function of initial velocity and kinetic energy. Numerical data are given, for velocities up to 6×10^9 cm./sec., for the retardation and equivalent air thicknesses of H_2, N_2, O_2, He, Ne, A, H_2O, Al, Cu, Ag, Au, Pb, and mica.

N. M. B.

666. Absorption of Radium γ-Rays in Radioactive Salts. F. Běhounek. *Zeits. f. Physik*, 92. 7–8. *pp.* 533–542, *Nov.* 30, 1934.—A series of measurements of the absorption of radium γ-rays (1·1 cm. Pb filter) in 30 salts ranging in apparent density from 0·503 to 3·88 gm./cm.^{3} indicates that there is no definite relationship between the mass-absorption co-efficient and the apparent density. The absorption coefficient, which ranges from 0·023 to 0·241 cm.$^{-1}$, is a function of the number of free electrons per cubic cm., a linear relationship existing for salts in which the atomic number of the kation is less than 56. A similar result is derived from Kohlrausch's measurements, although it cannot be interpreted theoretically. The paper concludes with an example of the application of the results to the calculation of the correction for absorption in the salt in radium measurements. [See also Abstract 3789 (1932).]

W. E. P.

See also Abstracts 538, 708, 713, 843, 844, 845, 881, 884, 902.

RADIATION.

ABSORPTION AND TRANSMISSION.

667. Ultra-Violet Transmission Changes in Glass. W. W. Coblentz and R. Stair. *Bureau of Standards, J. of Research,* 13. *pp.* 773–797, *Dec.,* 1934.—The paper describes (*a*) the results of studies of the depreciation and appreciation of ultra-violet transmission of window glass by exposure to filtered and unfiltered heterogeneous radiation from the sun and from the quartz mercury arc, and (*b*) some preliminary results of similar studies of photochemical changes in glass produced by isolated wave-lengths of quartz mercury arc radiation. Accelerating the stabilisation of window glass by means of filtered ultra-violet radiation is shown to be impracticable and reasons for this are given. A new phenomenon in the behaviour of certain glasses is described. In the soda-lime-silica glasses, the photochemical equilibrium was found to be different for each wave-length and no wave-length was found to have the exclusive property of decreasing or increasing the ultra-violet transmission. The photochemical action is a function of the wave-length, the longest effective wave-length being 405 $m\mu$. A phosphate-lime glass is depreciated in ultra-violet transmission only by wave-lengths shorter than 290 $m\mu$. After depreciation the spectral transmission curve is similar to that of a soda-lime glass. However, exposure of depreciated calcium phosphate glass to homogeneous radiation does not appreciate the transmission, as is the case in the soda-lime-silica glass. W. E. P.

See also Abstract 653.

COLORIMETRY.

***668. Maxwell Triangle Yielding Uniform Chromaticity Scales. D. B. Judd.** *Bureau of Standards, J. of Research,* 14. *pp.* 41–57, *Jan.,* 1935. *J.O.S.A.* 25. *pp.* 24–35, *Jan.,* 1935.—A colorimetric coordinate system has been found by trial and error whose Maxwell triangle has the useful property that the length of any line on it is a close measure of the chromaticity difference between the stimuli represented at the extremes of the line. Such accurate chromaticity scales may be derived from this triangle merely by stepping off equal intervals on it that it has been called the " uniform-scale triangle." The definition of the system is given, and also a comparison of experimental sensibility data with corresponding data derived from the triangle. An important application of this coordinate system is its use in finding from any series of colours the one most resembling a neighbouring colour of the same brilliance, for example, the finding of the nearest colour temperature for a neighbouring non-Planckian stimulus. The method is to draw the shortest line from the point representing the non-Planckian stimulus to the Planckian locus. AUTHOR.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

669. Magnetic Birefringence of Organic Liquids. E. Matull. *Ann. d. Physik,* 21. 4. *pp.* 345–366, *Dec.,* 1934.—The object of the work was to investigate quantitatively the magnetic birefringence of some organic liquids. The method employed is fully described and discussed, and there is also a discussion of the results and the probable sources of error. The magnetic birefringence of $C_6H_5CH_3$, C_6H_6, $C_6H_3(CH_3)_3$, CCl_4, $CHCl_3$ was determined. C_6H_6, $C_6H_3(CH_3)_3$ and $CHCl_4$ gave new values for the Cotton-Mouton constant. R. L.

***670. Technique of Kerr Cells. H. J. White.** *Rev. Sci. Instruments*, 6. *pp.* 22–26, *Jan.*, 1935.—The paper gives reasons for the necessity of purifying the nitrobenzene used in the construction of Kerr cells and describes in detail the operations necessary for effecting this purification, namely: (1) treatment with a weak basic solution to remove traces of acid, (2) treatment with a drying agent to remove as much water as possible, (3) fractional distillation, both at atmospheric and at reduced pressure, and (4) fractional freezing. Details are also given of the technique of the construction of Kerr cells of the h.v. low-capacity type, designed to operate over a range of voltages from 3–50 kV. R. L.

***671. Time-Lags in Magneto-Optics. H. W. Farwell and J. B. Hawkes.** *Phys. Rev.* 47. *pp.* 78–84, *Jan.* 1, 1935.—A modification has been introduced in the apparatus usually employed for the time-lag experiments, thereby enabling photometric measurements to be made. Minima were observed, but they were not confined to definite trolley positions. This apparatus has served to emphasise the variations in the exciting magnetic field, but has not disclosed evidence to support the view that sharp minima due to other causes are present. AUTHORS.

672. Optical Anisotropy, Form and Internal Mobility of Organic Molecules. H. A. Stuart and H. Volkmann. *Zeits. f. techn. Physik*, 15. 12. *pp.* 564–566, 1934. *Phys. Zeits.* 35. *pp.* 988–990, *Dec.* 1, 1934.—The Kerr constants of normal and branched hydrocarbons (ethane, propane, . . . *n*-dodecane) have been measured in the vapour state and the optical anisotropy of the respective molecules determined. From the course of the optical anisotropy it follows that the molecules do not form extended zig-zag chains in the vapour state, but more probably a compact ball in which the whole molecule is wound spirally. The internal molecular forces are consequently so small that even at room-temperature an average value is measured on account of the free rotatability of the possible molecular forms. From the measurements of ethers and ketones it follows that the presence of polar groups entails considerable chain extension. H. H. Ho.

See also Abstracts 692, 695.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

673. Fluorescence of Liquids. J. Franck and Hilde Levi. *Zeits. f. phys. Chem.* 27. *Abt.B.* 5–6. *pp.* 409–420, 1934.—An explanation of the fluorescence of liquids is sought by analogy with that of gases. It is considered that there must be an intimate relation between quenching of fluorescence by collisions and chemical reactivity between the colliding partners. The quenching of chlorophyll fluorescence in alcoholic solution by different substances added has been studied in detail. It is found that previous results, which are said to indicate that oxygen is activated directly by the fluorescing dyestuff are not in line with other cases where it appears certain that the oxygen acceptor takes up the energy and in this way renders the oxygen reactive. J. E.

674. Luminescence and Crystal Structure of Solidified Gases. L. Vegard. *K. Akad. Amsterdam, Proc.* 37. 10. *pp.* 780–788. 1934.—It appeared from earlier experiments that the luminescence of solid A and Ne was due to a common impurity. To settle the question experiments have been done with solid Kr. The results show that the series θ, S and ψ do not originate from the inert gas but from a common impurity difficult to remove. This is probably nitrogen. There appear to be infra-red bands common to solid nitrogen and an argon-nitrogen mixture. An explanation of the loss of phosphorescence when solid nitrogen is converted from the α- to the β-form is given in terms of the difference in crystal structure, this difference lying notably in the fact that in β-nitrogen the molecules rotate while in α-nitrogen they are fixed. It is considered that the rotation helps immediate recombination of dissociated molecules and thus abolishes phosphorescence in the β-form. J. E.

675. Luminescence in Water Carrying Supersonic Waves. J. Frenzel and H. Schultes. *Zeits. f. phys. Chem.* 27. *Abt.B.* 5–6. *pp.* 421–424, 1934.—Supersonic waves produce luminescence in redistilled water. Degassed water does not show the phenomenon. Addition of Heyden's oil (manufacturer's name) strengthens the luminescence. It is considered to be connected with the observation of Beuthe that the friction between gas bubbles and water gives rise to luminescence. J. E.

See also Abstract 561.

INTERFERENCE. DIFFRACTION AND SCATTERING.

676. Interference Colours in Oil Films on Water. Katharine B. Blodgett. *J.O.S.A.* 24. *pp.* 313–315, *Dec.*, 1934.—By suitable choice of a high grade motor lubricating oil, and oxidising it in the laboratory by heating, films of any desired thickness may be obtained if a drop of the oil is placed on the surface of pure water contained in a suitable trough. By testing the oil, stage by stage, during oxidation this process can be stopped when desired. By diluting the oxidised oil with successive small amounts of a non-spreading oil any desired thickness can be obtained. Thin films of motor oil are rapidly oxidised by sunlight and the change is shown by successive colour changes towards the shorter wave lengths. The change in thickness can also be obtained by confining the oil film on water by means of a movable barrier. A table is given of the results obtained in measuring film thickness by this method. R. S. R.

677. Scattering of de Broglie Waves. J. Winter. *Ann. de Physique*, 2. *pp.* 455–560, *Dec.*, 1934.—The general theory is reviewed of the scattering of light by spherical obstacles; a plane monochromatic de Broglie wave is resolved as a sum of waves, and each partial wave is resolved into a converging and diverging wave, the effect of the obstacle being to introduce a phase factor. In order to interpret these results, and to estimate the value of the electronic flux scattered in a given direction by an obstacle such as a gas atom, a flux definition: imaginary part of ψ grad ψ^*, is introduced instead of the expression $|\psi|^2$. For incident electrons of very high or very low energy the two methods give the same results for lateral flux. An analysis of the Rayleigh resolution formula for the plane wave is made by a study of the scattering of high voltage electrons and α-particles by the method of successive approximations. The potential is introduced as a perturbation term in the equation of the electronic waves. The formula obtained for the scattered flux (Born's formula) is, in the limit for high speed particles, Rutherfords classical formula, and is an asymptotic limit. The limiting conditions for the validity of Rutherford's formula and for the convergence of Born's formula are investigated and discussed. N. M. B.

See also Abstracts 701, 759, 760.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

678. Budde Effect in Iodine. T. S. Narayana. *Indian Journ. Phys.* 9. *pp.* 111–120, *Nov.*, 1934.—On the basis of the mechanism put forward [see Abstract 4976 (1934)] it was predicted that all homopolar diatomic gases should show the Budde effect on absorption of light quanta of the continuous absorption (provided the energy of recombination is given out as thermal energy). Experiments to verify this conclusion were carried out in iodine, and a phenomenon similar to the Budde effect in Cl_2 and Br_2 was observed. The photo-expansion was found to be proportional to the light intensity and to the vapour pressure of iodine. It was found to be a maximum in the violet and orange regions of the spectrum when the iodine vapour pressure was 70 mm. and it is very difficult to explain this from present knowledge of absorption in diatomic molecules. The photo-expansion was found to diminish with temperature. The results are interpreted on the basis of R. W. Wood's results on the influence of moist and dry glass walls on the recombination of H atoms. A probable explanation for the rate of fall in the formation of phosgene at high temperatures is given. AUTHOR.

679. Optimum Composition of Uranyl Oxalate Solutions for Actinometry. G. S. Forbes and L. J. Heidt. *Am. Chem. Soc., J.* 56. *pp.* 2363–2365, *Nov.*, 1934.—In order better to adapt the uranyl oxalate solutions to the frequency and intensity of light employed with the uranyl oxalate actinometer, the present authors have found it necessary to vary the concentration of the components of the solution. The results of experiments carried out in order to determine the optimum composition of the solution show that if an actinometer solution 0·01 *M* in uranyl sulphate and 0·05 *M* in oxalic acid be diluted tenfold, the quantum yields at λλ 313, 280, 254 and 208 $m\mu$ respectively remain almost unchanged. At shorter wave-lengths the more dilute solution has important advantages. The substitution of uranyl oxalate for uranyl sulphate results in a considerable simplification in purification and the quantum yield remains unchanged. A solution containing 0·005 mole of uranyl oxalate and 0·0025 mole of oxalic acid per litre is also found to give the same yield. R. C. F.

680. Photolysis of Dry Ozone. L. J. Heidt and G. S. Forbes. *Am. Chem. Soc., J.* 56. *pp.* 2365–2368, *Nov.*, 1934.—Examines the photolysis of carefully purified dry ozone in monochromatic light of wavelengths 208, 254 and 280 $m\mu$ respectively, the experiments being carried out over a wide range of temperature and of total and partial pressures of ozone and of oxygen. Quantum yields as high as 6·7 were obtained indicating an energy chain mechanism, the total pressures ranging from 230–620 mm. of mercury, and the partial pressures of ozone and oxygen from 35–430 mm. and 15–585 mm. respectively. The ten-degree temperature coefficient of the quantum yield is approximately 1·2, this result being obtained from one experiment in which the temperature of the outside bath was changed from 25° to −80°. Finally, although no dependence upon wave-length was found the quantum yield is shown to be dependent upon total and partial pressures and upon light intensity, this dependency being very similar to that previously obtained when water vapour was present. R. C. F.

681. Decomposition of Ozone Photosensitised by Chlorine. R. G. W. Norrish and G. H. J. Neville. *Chem. Soc., J. pp.* 1864–1872, *Dec.*, 1934.—Decomposition was effected with light of λ 3650, and at 25°. With low concentrations of O_3 the reaction is of zero order and has a chain mechanism, γ (quantum efficiency) sometimes reaching 10; with high O_3 and low Cl_2 the rate $\propto \sqrt{I}$ (I = light flux), and chains are terminated by self-neutralisation. With high Cl_2 or O_2 the rate $\propto I$. As the pressure of O_2 or Cl_2 is increased, I being constant, γ decreases to a limiting value of 2. Foreign gases have no effect. $(ClO_3)_n$ may separate as a red liquid when concentrations of Cl_2 and O_3 are high, but provided this does not occur results are uniform and reproducible; if it does, decomposition continues with increase of pressure in the dark; this explains the "anomalous" result of Heidt, etc., [see Abstract 2637 (1932) and 1450 (1933)]. C. A. S.

682. Photoelectric Determination of Degree of Dissociation in the Equation $N_2O_4 \rightleftarrows 2NO_2$. K. Bergwitz and O. E. Schweckendiek. *Phys. Zeits.* 36. *p.* 35, *Jan.* 1, 1935.—The gases are contained in a quartz sphere of about 100 cc. capacity: the temperature is determined with a thermo-element and the pressure with a quartz spiral manometer. If the degree of dissociation is known for two values of (p, T), the dissociation for any other value is obtained by measurement of the light absorption with a photoelectric cell together with application of the Beer-Lambert law. The method is applicable to all systems one of the components of which has an absorption band in the visible or ultra-violet. F. C. C.

683. Photochemistry. M. Bodenstein. *Naturwiss.* 23. *pp.* 10–16, *Jan.* 4, 1935.—The fundamental principles of photochemistry developed during the past few years are considered, together with a few examples of their application. The similarities and differences between reactions excited by α- and X-rays and photochemical reactions are also discussed.

T. H. P.

684. Graininess and Resolving Power of Photographic Emulsions. A. van Krevald. *Phot. J.* 74. *pp.* 590–596, *Dec.*, 1934.—These properties are considered in terms of the microfluctuations in density as read by a recording microdensitometer, across a developed photographic image. The turbidity of the emulsion is determined from the density-gradation across the edge of the image of a field changing sharply in intensity. L. V. C.

685. Mechanism of the Desensitisation of Photographic Plates. Marietta Blau and Hertha Wambacher. *Zeits. f. wiss. Phot.* 33. *pp.* 191–197, *Dec.*, 1934.—Gives details of observations made in connection with previously published results [see Abstracts 13 and 14 (1935)] which are of interest with regard to the desensitisation of photographic materials. Pinakryptol yellow and similar dyes act as sensitisers for plates to be used for work with protons and α-particles, but the sensitising action is independent of its normal desensitising power. The dyes examined, with one exception, gave a positive effect if they contained a nitrogen group. This indicates that the structure of the dye is important and that the dye produces a change in the outer surface of the silver-bromide grain. The desensitisation power of the dyes is found to decrease with decreasing pressure, there being no difference between desensitised and normal plates at very low pressures, the desensitising power being also dependent upon the moisture content of the plate. This reduction in desensitisation with pressure is shown to be due to a reduction in oxygen content of the place of examination, thus indicating that the process is an oxidisation process. R. C. F.

686. Connection between DIN and Scheiner Values. M. Biltz and J. Eggert. *Fot. Indust.* 32. *pp.* 1296–1298, *Dec.* 5, 1934.—With the advent of emulsions graded according to the DIN system it became necessary to change from these values to Scheiner values and this resulted in an approximate rule being formulated. In order to determine whether there was any satisfactory relationship between the two methods of expressing sensitivity, the present authors examined 18 types of films deriving the required DIN and true Scheiner values. The results obtained show that it is possible to have two emulsions with identical Scheiner values, one of which is ten times as sensitive as the other according to the DIN values, the differences being partly due to the spectral differences of the illuminants used. Commercially the Scheiner values are usually empirically determined, and a comparison of DIN and commercial Scheiner values show a sensitivity range of 6. Thus the approximate rule given can result in the obtaining of a Scheiner value which has an error of ± 3° Scheiner. R. C. F.

687. Effect of Temperature upon Reciprocity Law Failure in Photographic Exposure. J. H. Webb. *Kodak Research Lab. Comm. No.* 538. *J.O.S.A.* 25. *pp.* 4–23, *Jan.*, 1935.—Measurements of the effect of temperature variation on the reciprocity failure curves were made for several types of emulsions and for radiation of several different wavelengths. The effect of temperature variation upon emulsion sensitivity is shown to be very strongly dependent upon the intensity level at which the exposures are made. At very low intensities it is found that the speeds of certain emulsions can be increased several fold by lowering the temperature. An analysis of the data suggests a possible manner of division of the reciprocity curves into two component parts which, presumably, correspond to two different modes of utilisation of the exposure in the formation of the latent image. A theoretical formulation based on the foregoing analysis yields the Kron-Halm catenary equation for representing the reciprocity failure curves. AUTHOR.

688. Influence of Salts upon Intermittent Photographic Exposures. T. H. James, J. M. Blair and F. E. E. Germann. *J. Phys. Chem.* 38. *pp.* 1023–1030, *Nov.*, 1934.—Deals with the influence upon the intermittency effect of many of the salts used by Narbutt [see Abstract 445 (1931)] as well as certain other salts whose action upon the Herschel effect is known. The results obtained show that washing increases the speed of the emulsion and reduces the intermittency effect, and that the effects of the various salts are all found to be in agreement with Narbutt's results obtained for continuous exposure. Thus, Narbutt's general observations as to the relation which exists between the influence of an ion upon the Herschel effect and its influence upon the sensitivity of the emulsion also apply to the intermittency effect. It is concluded that any salt which acts as a sensitiser or desensitiser for the Herschel effect will act in the same capacity for the intermittency effect. R. C. F.

***689. Solarisation of Low Intensity. A. J. Reardon and H. P. Griggs.** *J.O.S.A.* 24. *pp.* 331–338, *Dec.*, 1934.—After briefly discussing previously published results on the phenomenon of photographic reversal, the present authors give the results obtained during a period of 2½ years' examination of the solarisation region. The camera consisted of a long box with a 0·5 cm. opening at one end covered with a piece of ground photographic plate glass, the plate carrier at the other end being divided into four sections each capable of holding a 9 × 12 cm. plate. In front of each plate is placed a metal diaphragm containing 5 rows of 11 holes, each row being covered by a metal strip so that the holes can be uncovered one by one. Lamps of 400 and 1000 W. were used as light sources, and all plates were developed for 5 min. at 65 ± 1° F. The results given show that the solarisation curve beyond the second reversal contains a set of maximum and minimum points, the distances between adjacent maxima or minima increasing with increasing exposure time. In one case 16 reversals were obtained during an exposure time of 1759 hours. The age of the emulsion also affects the results, decreasing both the density resulting from the development of the latent image and the solarisation effect.

R. C. F.

690. Dufaycolour Process. F. F. Renwick. *Phot. J.* 75. *pp.* 28–35, *Jan.*, 1935.—Deals with some of the problems being investigated and gives a general idea of the progress made recently in the development of the Dufaycolour process. This process possesses advantages over others in that no special apparatus is required in making the original colour record, only one film is employed, the record in natural colours is obtained by a simple photographic technique, it permits the fullest use to be made of the light available, and satisfactory duplicates of the original record can be made either upon similar materials or as prints. Improvements in the manufacture of the colour film are first discussed, followed by a description of a reversal system of processing adopted to enable the results obtained to be viewed as positives. Compensating filters are then briefly considered, and contrast is dealt with rather more fully owing to the importance of correct contrast for correct colour rendering. Finally, copying is discussed in some detail, indicating important points in the making of copies by projection or by contact printing. R. C. F.

***691. Ultra-Speed Kinematograph Camera. T. Suhara.** *Imp. Acad. Tokyo, Proc.* 10. *pp.* 452–455, *Oct.*, 1934. *In English.*—Briefly describes an improved camera capable of taking photographs at the rate of 60,000 per sec., the camera being built on the same prinicple as that previously described [see Abstract 1423 (1930)]. Photographs are given illustrating a rifle bullet penetrating a steel plate (filming rate 53,400 pictures per sec.), and the free explosion of an ordinary rifle cartridge firmly fixed on a frame (filming rate 60,345 pictures per sec.). R. C. F.

692. Ultra-Short Time Effect and its Interpretation. A. Narath. *Zeits. f. wiss. Phot.* 33. *pp.* 145–150, *Oct., and pp.* 153–166, *Nov.*, 1934.—Extremely short duration of illumination is very important in sound film tecnique and in h.f. kinematography, and results in a deviation from the recipcocity law. The present author describes experiments undertaken to explain this deviation, using the electro-optical Kerr effect, which not only gives an easily produced ultra-short time-intensity scale but also allows of the examination of dispersion phenomena. Four different types of plates and three different developers were used, the time of illumination being 3×10^{-5} sec., and the development times varied between 2 and 20 min. The ultra-short time factor, for the outer surface developer used, is found to vary with the emulsion, being both above and below unity. The results also definitely show that the effect is a surface effect and that the colour sensitivity of the topmost layer determines the corresponding γ value. With the blue sensitive layer uppermost $\gamma > 1$ and with the yellow layer uppermost $\gamma < 1$. A dispersion effect of the development processes is established, for with increasing times of development the first turning point moves to higher voltage values for one emulsion and to lower values for another, thus indicating that the emulsions must possess successive spectral sensitivity regions. R. C. F.

***693. Direct Photography of Dust in Air. L. H. Ott and J. B. Ficklen.** *Rev. Sci. Instruments*, 6. *pp.* 4–5, *Jan.*, 1935.—Briefly describes a method of photographing dust particles in a light beam using the intense illumination from a photo-flash lamp. The rays from this lamp are passed through the sample of air containing the dust particles, by a slit system, and are afterwards reflected so that nearly twice the initial illumination is obtained. Permanent records of dust particles from 0·1 to 100 μ can be obtained by this means. R. C. F.

694. Distortion of Photographic Emulsions. Part II (continued). Films. G. Berndt. *Zeits. f. Instrumentenk.* 54. *pp.* 452–455, *Dec.*, 1934.—Measurements were made on films after development, fixing washing and drying at temperatures of 25° and 50° C. and relative humidities of 30 % and 100 %, the films having been exposed previously with each of these conditions existing. The results of distortion and crinkling are tabulated and shown in diagrams. Films, in opposition to plates, show a distinct linear crinkling of 0 to 0·76 % with local distortions and it is the same in all directions. The crinkling is affected by temperature (t) and relative humidity (f), and is greatest with f low and t high. [See Abstract 3683 (1934).] R. S. R.

695. New Method of Investigating Photographic Processes by Means of the Electro-Optical Kerr Effect. A. Narath. *Zeits. f. techn. Physik*, 15. 12. *pp.* 568–572, 1934. *Phys. Zeits.* 35. *pp.* 992–996, *Dec.* 1, 1934.—Photography of the characteristic curves of the Kerr cell allows quantitative conclusions to be drawn concerning the intensity and wave-length of actinic light. For monochromatic light (436 mμ) this proved possible up to the ninth maximum, but deviation from theory is caused by a superposed continuous spectrum. Perfect agreement is, however, obtained when a sodium-vapour lamp is used; no dichroism is observed even with the highest strengths of field (2×10^5 volt/cm.). For polychromatic light the characteristics may be calculated, and this is done for bands of a continuous spectrum of constant intensity ranging from 10 to 120 mμ in width. At high strengths of field the ratio of the transmitted intensity to the constant intensity of the light current approaches 0·5 the more rapidly as the band is broadened. These results may be applied to the interpretation of photographic processes. T. H. P.

See also Abstracts 762, 770, 839, 889, 890, 901, 919.

PHOTOMETRY.

696. Photometry and Energy Distribution of the High-Intensity Mercury Lamp. L. B. Johnson. *J.O.S.A.* 25. *pp.* 36–38, *Jan.*, 1935.—Describes a method of comparing the high-intensity mercury lamp with a low-intensity mercury lamp in which only individual lines are compared, thereby giving a colour match which is also an energy match. Monochromatic filters are placed between the eye and eyepiece of a Lummer-Brodhun photometer head, two low-intensity mercury lamps side by side forming the standard with a candle-power of 1374. The candle-power of the standard is divided into three groups—yellow, green and blue—and as energy distributions and relative visibilities of the groups are known, these figures enable the percentage candle power for each group to be determined. Ratios of the group intensities of the high-intensity lamp to those of the low pressure lamps are measured by the method described, the candle power of one high-intensity lamp being calculated to be 1437 c.p. and its lumen output 14,300. The average value for 5 high-intensity lamps, using the monochromatic method of measurement, is found to be 14,200 lumens. R. C. F.

***697. Measurement of Visible and Ultra-Violet Radiation by Geiger Counter. Z. Ollano.** *N. Cimento,* 11. *pp.* 603–620, *Nov.,* 1934.—Describes a modification of the Geiger counter intended for the measurement of radiation in the visible spectrum and in the ultra-violet. The cylinder is furnished with a quartz window and is coated internally with a photoelectrically sensitive layer. The author has studied the sensitivities of a number of different substances, including Al, Cu, Cd, brass, brass amalgam, CuO and Cu_2O, and has measured their response to radiation of various wave-lengths. He finds that the sensitivity of Al is nearly constant from 579 to 310 $m\mu$; that of an amalgam of brass with mercury and sodium is very high in the ultra-violet; that of Cu_2O shows a peak in the visible spectrum. J. W. T. W.

***698. Microphotometer for the Study of Emission Spectra. R. Breckpot.** *Ann. Soc. Sci. de Bruxelles,* 54. *pp.* 299–314, *Dec.* 17, 1934.—A microphotometric arrangement specially suitable for spectral analysis is described. The image of the plate is projected on to a horizontal screen provided with a central opening below which are placed the slit, photoelectric cell and electrometer. The deflections are projected back on to the screen so that the deflections and the spectrum under examination are both in view. Full details of the apparatus are given and of its use with the logarithmic sector method previously given [see Abstract 3318 (1934)]. The factors influencing the measurements, *i.e.* sensitivity, resolving power, and illumination are fully discussed, and the details of the calculation of intensities from the deflections are given. W. R. A.

***699. Self-Registering Microphotometer. L. A. Woodward and R. G. Horner.** *Journ. Sci. Instruments,* 12. *pp.* 17–22, *Jan.,* 1935.—A description is given of a new type of self-registering microphotometer which involves no gearing or lever drive, both the plate under examination and the recording plate being fixed. An image of the plate under examination is formed at any desired magnification by a projector, and the intensity distribution in this image is explored by moving slowly across it the whole photometer unit comprising the exploring slit, photoelectric cell, electrometer and optical train for projecting an image of the electrometer fibre on to the recording plate. The motion is uniform and free from vibration, being gravity-operated against an oil leak. The absence of mechanical transmission, and the fact that the movement and components are on the relatively large scale of the record, make for accuracy combined with ease and cheapness of construction. AUTHORS.

***700. Precision Radiation Integrator. R. H. Müller and G. E. Shriver.** *Rev. Sci. Instruments*, 6. *pp.* 16–21, *Jan.*, 1935.—The condenser-photoelectric cell method of radiation integration has been investigated in detail and refined to the extent of yielding an instrument capable of precise integration over long periods of operation. A vacuum photoelectric cell charges an air-condenser placed in the input circuit of an FP-54 tube. The output of the latter operates two '58 tubes in parallel which actuate two relays, one operating a cyclometer counter, the other discharging the condenser. Automatic compensation is provided throughout to maintain stability. Suitable tests are reported indicating the sensitivity, reproducibility and overall reliability of the instrument. Over long periods the integration is reliable to 3 parts in 1000 and for a single photometric measurement to 1 part in 1000. AUTHORS.

See also Abstract 695.

POLARISATION.

701. Rayleigh Scattered Radiation in Crystals. F. Matossi. *Zeits. f. Physik*, 92. 7–8. *pp.* 425–461, *Nov.* 30, 1934.—The degree of depolarisation of molecular Rayleigh scattered radiation in crystals is investigated as a function of the orientation of the crystal. The theory is developed for rhombic, trigonal, hexagonal and tetragonal crystals. One important theoretical deduction is that under certain circumstances the elastic constants of a crystal may exhibit a lower degree of symmetry than the optical constants and give rise to an " anisotropic " effect. Experimentally the degree of depolarisation in glass, rock-salt, topaz, Iceland spar, and quartz is investigated, the scattering in the three first named crystals being of non-molecular origin, and in the last two of molecular origin. Quartz exhibits the " anisotropic " effect in satisfactory agreement with theory, but the corresponding effect in Iceland spar shows no quantitative agreement with theory. The polarisation of Raman scattered radiation in Iceland spar is briefly discussed. J. E. K.

***702. Simplified Half-Shadow Elliptic Detector of Bravais Biplate Type. E. Perucca.** *N. Ciments*, 11. *pp.* 701–707, *Dec.*, 1934. *Journ. Sci. Instruments*, 12. *pp.* 8–10. *Jan.*, 1935.—A simple method of constructing a biplate which acts as a Bravais biplate is described and its use as a sensitive instrument for the measurement of the ellipticity of polarised light recommended. AUTHOR.

See also Abstract 758.

RADIATION, EMISSION.

***703. Construction and Test of an A.C. Bolometer. P. Moon and W. R. Mills, Jr.** *Rev. Sci. Instruments*, 6. *pp.* 8–15, *Jan.*, 1935.—The purpose of the paper is to describe the construction and test of an a.c. bolometer which was recently built at the Massachusetts Institute of Technology. Previous theoretical work had indicated that such an instrument would be of value in the measurement of radiation and would possess certain advantages over previous devices used for that purpose. Tests substantiate the predictions of the theory. The a.c. bolometer is found to be rugged, easily operated, not susceptible to vibration and unaffected by spurious thermal e.m.f.'s. The sensitivity obtained with an experimental cell using 0·0016-inch tungsten wire was 0·068 volt per watt/cm.^{2} which was in good agreement with theory. There seems to be no reason why cells made with smaller wires should not give sensitivities of five or ten times this value. Experimental results are also given for bolometer response as a function of current and of time. AUTHORS.

704. Structure of the Ionised Layer of the Atmosphere (Ionosphere). T. Ionescu and C. Mihul. *Comptes Rendus,* 199. *pp.* 1301–1303, *Dec.* 3, 1934.—Measurements were made on the reflection of electromagnetic waves, assuming that one ionised layer exists in the upper air with an electronic density (N) varying continuously with height. Curves show the results obtained with real and apparent reflection. It is concluded that (1) the discontinuities observed are only apparent and that the real reflection levels vary continuously; (2) reflections are partial and not total, thus accounting for the observed loss of energy; (3) total reflection is only a special case when passing from one layer to the next; (4) the range of frequencies reflected for a given layer is a function of N and varies with height, while with N increasing slowly with height multiple reflections occur for a certain wave-length; and (5) for frequencies greater than those of the discontinuities there are two levels causing reflection. **Errata,** *ibid., p.* 1693, *Dec.* 26, 1934. R. S. R.

705. Propagation of Electric Waves; Explanation of Echoes. T. Ionescu and C. Mihul. *Comptes Rendus,* 199. *pp.* 1389–1391, *Dec.* 10, 1934.—Reference is made to the results obtained in a previous paper [see preceding Abstract] on the reflection of electric waves by the ionosphere. It is shown that the long-distance transmission of electric waves can be explained by assuming that in these cases the interval between successive collisions of the electron and molecules is nearly an exact multiple of the period of the wave used. The different types of echoes are accounted for by reflection from different regions in the ionosphere, and by concentration of the energy into this canal the long-distance signal is more easily observed. R. S. R.

706. Characteristics of Downcoming Radio Waves. D. F. Martyn and A. L. Green. *Roy. Soc., Proc.* 148A. *pp.* 104–120, *Jan.* 1, 1935.—It is shown that the inconsistent results obtained by other workers when measuring the angle of incidence of downcoming radio waves are mainly due to lateral deviation of the elliptically polarised wave from the plane of propagation. A new method of measurement of these angles, which is unaffected by the presence of lateral deviation is described. Using this method, which involves simultaneous reception of signals on three aerial systems, it has been possible to determine all the electrical and geometrical characteristics of the downcoming waves and their variations from second to second. It is found that the measured angles of incidence of the downcoming rays from both E- and F-layers approach the values corresponding to symmetrical reflection, and that a considerable amount of lateral deviation of the downcoming ray is normally present. The polarisation of the downcoming wave is normally right-handed and approximately circular, but marked departures from the circular form occur. These departures appear to be correlated with the angle between the downcoming ray and the earth's magnetic field. AUTHORS.

707. Researches on Cosmic Rays at Scoresby Sound During the Polar Year. A. Dauvillier. *J. de Physique et le Radium.* 5. *pp.* 640–648, *Dec.,* 1934.—A detailed account of the instruments used, methods of observation, and results previously given in summary form [see Abstract 1129 (1934)], together with a more elaborate discussion of the author's theory regarding the origin of cosmic rays and their connection with auroral and magnetic phenomena [see Abstract 3229 (1934)]. C. A. S.

***708. Precision Recording Cosmic-Ray Meter. A. H. Compton, E. O. Wollan and R. D. Bennett.** *Rev. Sci. Instruments*, 5. *pp.* 415–422, *Dec.*, 1934.—A precision recording cosmic-ray meter is described consisting essentially of (1) a spherical bomb ionisation chamber of 19·3 l. volume filled with A at 50 atmospheres, (2) a balancing chamber within the sphere and having its ionisation produced by β-rays emitted from an adjustable surface of metallic U. The difference between the two ionisation currents is recorded photographically with a Lindemann electrometer; with a roll of bromide paper 18 m. in length the apparatus will run continuously for more than a month. The barometric pressure from a Paulin barometer and the temperature of the meter from a bimetallic thermometer placed beside the cylindrical lens of the camera are also recorded. The zero reading was obtained down a coal-mine 110 m. deep. A 36-hour record was reproduced showing the variation of cosmic-ray intensity with barometric pressure, and also three prominent " bursts." F. C. C.

709. Counter Calibration and Cosmic-Ray Intensity. J. C. Street and R. H. Woodward. *Phys. Rev.* 46. *pp.* 1029–1034, *Dec.* 15, 1934.—An absolute calibration of a set of counters has been obtained by determining their efficiencies and effective volumes. From observations recorded with this calibrated set, the number of ionising cosmic rays is $0{\cdot}80 \pm 0{\cdot}028$ cm^{-2}. min^{-1} from unit solid angle at the vertical at sea level. The number of such rays from all directions as obtained by integration over an angular distribution curve is $1{\cdot}48 \pm 0{\cdot}055$ cm^{-2} min.$^{-1}$. This combined with Millikan's ionisation chamber measurements gives an average specific ionisation of $100 \pm 3{\cdot}7$ ion pairs per cm. path of a ray. Comparison with previous measurements is made. AUTHORS.

710. Origin of Cosmic Rays. A. F. Stevenson. *Phys. Rev.* 46. *pp.* 1111–1112, *Dec.* 15, 1934.—The author points out an error in the mathematical analysis given in a recent paper [see Abstract 276 (1935)] of the consequences of the assumption that the earth carries an electric charge and attracts charged particles, distributed uniformly at infinity, which constitute the cosmic radiation. The hypothesis is not ruled out but the quantitative conclusions there reached are invalidated; the theory is, if anything, rather improved by this criticism. D. H. F.

711. Absorption of Cosmic Rays by Different Substances. H. Tielsch. *Zeits. f. Physik*, 92. 9–10. *pp.* 589-614, *Dec.* 4, 1934.—Measurements on the absorption of cosmic rays by different thicknesses of various materials were carried out with a high pressure ionisation chamber, with 16 cm. of Pb between the absorber and the chamber. In the course of these measurements data were obtained on the variation of the radiation with barometric pressure, time and temperature. Disturbing effects due to these factors were eliminated by the method of observation. For the different materials the thicknesses giving the same absorption were determined and hence the absolute absorption coefficient calculated. The results are discussed and it is concluded that it is very improbable that the radiation is electromagnetic. Calculations made for the variation of the absorption per extra-nuclear electron with the atomic number agreed with the observed results. D. H. F.

712. Analysis of Cosmic Ray Absorption Curves. B. Gross. *Zeits. f. Physik*, 92. 11–12. *pp.* 755–758, *Dec.* 10, 1934.—It is proposed that, in cosmic ray absorption measurements by ionisation chamber methods, the effect of residual ionisation can be taken into account precisely by differentiating the absorption curve. An application to the Regener-Kramer results is given. D. H. F.

713. Absorption Formulæ for High Energy Radiations. J. R. Oppenheimer. *Phys. Rev.* 47. *pp.* 44–52, *Jan.* 1, 1935.—In this paper we consider the discrepancies between theoretical prediction and experiment for the absorption of cosmic-ray electrons and γ-rays. By applying a strict criterion for the validity of classical electron theory, it is possible to derive new formulæ for impact and radiative energy losses of high energy electrons, which may be regarded as theoretical lower limits for these quantities, and which are in far better agreement with experiment than the formulæ given by an uncritical application of quantum mechanics to these problems. These limitations on classical electron theory are consistent with those given by possible unitary classical field theories, but are more incisive than those given by the unitary theory of Born. AUTHOR.

714. Penetrating Corpuscular Radiation. H. Kulenkampff. *Zeits. f. techn. Physik,* 15. 12. *pp.* 572–573, 1934. *Phys. Zeits.* 35. *pp.* 996–997, *Dec.* 1, 1934.—Using an Fe absorber, the results of Maass [see Abstract 5005 (1934)] are confirmed. The phenomena observed by both experimenters are attributed to the production of showers at small thicknesses and to the production of a secondary γ-radiation at large thicknesses of absorber, respectively. F. C. C.

See also Abstracts **696, 700, 716, 732, 733, 762, 777.**

RADIATION, GENERAL THEORY.

715. Planck's Quanta and the Atomic Field of Force. M. Brillouin. *Comptes Rendus,* 199. *pp.* 1345–1349, *Dec.* 10, 1934.—It is suggested that Planck's constant should appear as a fundamental constant of the atomic field governing the motion of the electrons and the interactions of atoms instead of being introduced artificially along with Coulomb's and Maxwell's laws. Expressions are found by classical mechanics for the central field forces such that, for each circular trajectory centred on an electron in the field, the period and total energy of motion may be connected by Planck's law, and the conditions satisfying these relations are examined and discussed. **Erratum,** *ibid., p.* 1693, *Dec.* 26, 1934. N. M. B.

716. Collision of Two Light Quanta. G. Breit and J. A. Wheeler. *Phys. Rev.* 46. *pp.* 1087–1091, *Dec.* 15, 1934.—The recombination of free electrons and free positrons and its connection with the Compton effect have been treated by Dirac before the experimental discovery of the positron. In the present note are given analogous calculations for the production of positron electron pairs as a result of the collision of two light quanta. The angular distribution of the ejected pairs is calculated for different polarisations, and formulæ are given for the angular distribution of photons due to recombination. The results are applied to the collision of high energy photons of cosmic radiation with the temperature radiation of interstellar space. The effect on the absorption of such quanta is found to be negligibly small. AUTHORS.

See also Abstract **882.**

REFLECTION. REFRACTION AND DISPERSION.

717. Optical Reflection by Silver Mirrors in the Region of Transition from the Amorphous to the Crystalline State at Low Temperatures. R. Suhrmann and G. Barth. *Zeits. f. techn. Physik,* 15. 12. *pp.* 547–549, 1934. *Phys. Zeits.* 35. *pp.* 971–973, *Dec.* 1, 1934.—

The decrease of the electrical resistance of a silver mirror, deposited at about 20° Abs, in a high vacuum, as the temperature is raised to 390° Abs., is accompanied by a parallel increase of reflecting power. The initial decrease of resistance is accompanied by an increase of reflectivity principally in the region of long wave-lengths; subsequently the increase of reflectivity occurs principally in the visible and ultra-violet regions. These results are attributed to a transition from the amorphous to the metallic state, the weakly bound electrons being first transformed into metallic electrons, and the strongly bound electrons being subsequently so transformed. J. S. G. T.

718. Huygens' Principle Applied to Reflection of a Spherical Light Wave from a Moving Plane Mirror. N. Galli-Shohat. *J.O.S.A.* 25. *pp.* 39–41, *Jan.*, 1935.—By the application of Huygens' principle it is shown that a spherical light wave is reflected from a plane mirror moving towards the source as if from a concave mirror fixed in space, and the position, shape and dimensions of this mirror are determined. C. B. A.

719. Main Propositions of the Delineation of the Surroundings of Rays in General Optical Systems. M. Herzberger. *Zeits. f. Instrumentenk.* 54. *pp.* 337–350, *Oct.*; 381–392, *Nov. and pp.* 429–441, *Dec.*, 1934.—The paper contains a full statement of the theory of refraction in general optical systems. The following subjects are dealt with successively, (1) properties of first order rays in a normal bundle by vector and scalar; (2) calculations with symmetrical matrices of the coordinate vectors and scalars; (3) delineation of the surroundings of the main rays; Bruns' equations and transformation formulæ; (4) delineation of points for the infinitely distant object and image; (5) delineation of a given normal congruence; (6) delineation of points for the main rays; (7) relations between matrices of the appropriate scalars and vectors; fundamental invariants; (8) statement of a normal coordinate system; (9) the Gaussian system; (10) the orthogonal system; (11) the non-orthogonal system; (12) astigmatic rays; (13) the Schleiermacher equations; (14) application of the above for refraction at individual surfaces; (15) point coordinates; non-focal and semi-focal systems; (16) Sturm formulæ for refraction, and the Gullstrand fundamental equations. Finally, a summary is given of historical methods of treatment of this subject from the time of Clerk Maxwell to recent work by T. Smith and by Boegehold. R. S. R.

720. Investigation of Slit Images. Part II. W. Philippoff. *Zeits. f. Instrumentenk.* 54. *pp.* 393–396, *Nov.*, 1934.—A theoretical investigation was made earlier of the influence of refraction on slit images of finite width and the change of maximum intensity as a function of the aperture and slit width [see Abstract 4182 (1934)]. The results of an experimental test of this theory are given. With the help of colour filters and photographic registration the maximum intensity of the image was obtained for slits of different sizes. The experimental results agree qualitatively with theory and do not differ by more than 10 %. R. S. R.

721. Calculations for Thin Objectives with Three Glass Components. A. Biot. *Ann. Soc. Sci. de Bruxelles*, 54. *pp.* 207–211, *Dec.* 17, 1934.—Calculations necessary to obtain the paths of rays through these objectives are complicated on account of the correction for spherical aberration for a point at infinity along the axis and for the suppression of coma. A simplified procedure is given for the calculations for the general case with three different materials, and for a special case of two different materials, by which the process may be shortened. R. S. R.

***722. Radiation and Wave Optics. F. Trey and J. Fridrichsons.** *Phys. Zeits.* 35. *p.* 1012, *Dec.* 15, 1934.—Details for the experimental demonstration of the shadows of an object given by light concentrated by different methods are discussed. W. R. A.

723. Anisotropy of Optical Polarisation Field in Liquids. M. Ramanadham. *Indian Acad. Sci., Proc.* 1*A*. *pp.* 281–287, *Nov.*, 1934.—The theory of the anisotropic polarisation field developed by Raman and Krishnan has been applied to calculate the refractivities of a number of organic vapours from the known refractive indices in the liquid state. The observed values are found to agree better with those calculated on the above basis than those obtained with the help of Lorentz's formula. AUTHOR.

724. Refractive Indices of Guanidonium Iodide. W. Theilacker. *Zeits. f. Krist.* 90. *pp.* 77–81, *Jan.*, 1935.—The method of Bragg is used, and leads to the following values—$\epsilon = 1\cdot549$; $\omega = 1\cdot745$. The birefringence is thus extreme, confirming the planar configuration of the guanidonium ion [see Abstract 558 1935)]. F. I. G. R.

725. Anisotropy and Structure of Window Glass. P. Gaubert. *Comptes Rendus*, 199. *pp.* 1402–1404, *Dec.* 10, 1934.—A study of the optical properties of homogeneous plates of window and similar glass shows that they resemble optically-negative uniaxial crystalline plates with the axis perpendicular to the surface. A detailed account of the more complicated relationships existing in inhomogeneous plates is also given. C. B. A.

***726. Simple Procedure for Following Quickly Moving Objects. W. Schmidt.** *Zeits. f. Instrumentenk*, 54. *pp.* 455–457, *Dec.*, 1934.—On account of difficulties in using a theodolite to follow objects whose speed and direction were changing rapidly a type of mirror nephoscope was used. The mirror was displaced to keep the image of the object central in the mirror and a style attached to the lower surface traced the movements of the mirror on prepared paper and thus indirectly gave the track of the object observed. Time marks could also be made at 5 sec. intervals. The apparatus was particularly useful in following by means of small balloons the flow of air in closed rooms during heating processes or the travel of clouds. R. S. R.

***727. Objective for Infra-Red. H. R. Schulz.** *Zeits. f. Physik*, 92. 7–8. *pp.* 523–527, *Nov.* 30, 1934.—A triple objective is developed for the infra-red, which corrects for spherical and chromatic aberration. The objective is a combination of quartz or flint glass with rock-salt, sylvine or other similar substance. A new transparent cement is used. J. T.

See also Abstracts 559, 595, 783.

SPECTROSCOPY.

728. Spark Spectrum of Iodine. P. N. Kalia. *Indian Journ. Phys.* 9. *pp.* 179–188, *Nov.*, 1934.—123 new lines of ionised iodine have been measured between λ1275 and λ2376, using a 1 m. vacuum grating. The spectrum was excited by electrodeless discharge in tubes filled with iodine vapour at less than 0·05 mm. pressure. AUTHOR.

729. Arc Spectrum of Europium. H. N. Russell and A. S. King. *Phys. Rev.* 46. *pp.* 1023–1024, *Dec.* 1, 1934.—An extension of the temperature classification for longer waves confirms the structure of the spectrum predicted by Albertson. The lines which have been classified are tabulated as multiplets, other values being used and supplemented to the red of 7400 Å. The principal ionisation potential is given as 5·64 volts. Many strong lines are still unclassified. F. S.

730. Induced Predissociation in Te_2 Molecules. V. Kondratjew and A. Lauris. *Zeits. f. Physik*, 92. 11–12. *pp*. 741–746, *Dec*. 10, 1934.—A study of the absorption spectrum of Te vapour in the presence of N_2 shows that the absorption coefficients of the earlier terms of the Deslandres series undergo a selective increase which is related to the dissociation of the excited Te_2 molecules induced by collisions with foreign molecules. It is shown that the non-stationary state of the Te_2 molecules controlling the predissociation can be a $^3\Pi_g$ state. On the basis of new and older data, potential energy curves for the four electronic states of the Te_2 molecule so far known are constructed. C. B. A.

731. Broadening and Displacement of Absorption Lines. C. Füchtbauer. *Zeits. f. techn. Physik*, 15. 12. *pp*. 551–553, 1934. *Phys. Zeits*. 35. *pp*. 975–977, *Dec*. 1, 1934.—The displacements of the higher series lines of Na and K by He, Ne, A and of Cs by these inert gases and Hg vapour have been measured. The half-value breadths of the lines have also been estimated. [See Abstract 4703 (1934).] W. R. A.

732. Radiational Properties of Discharge in Mercury Vapour. H. Krefft. *Zeits. f. techn. Physik*, 15. 12. *pp*. 554–556, 1934. *Phys. Zeits*. 35. *pp*. 978–980, *Dec*. 1, 1934.—The absolute radiational yield of 29 series lines of the mercury discharge have been estimated by varying the pressure in the column between 0·01 and 1000 mm. The values are in good agreement with previously recorded data. The yield is a reproducible property of the discharge. The influence of current strength and pressure on the continuous background has also been investigated. W. R. A.

733. Regularities in the Emitted Radiation of the Positive Column of the Neon Discharge. H. Krefft and E. O. Seitz. *Zeits. f. techn. Physik*, 15. 12. *pp*. 556–559, 1934. *Phys. Zeits*. 35. *pp*. 980–983, *Dec*. 1, 1934.—The red lines produced by excitation in the positive column of the discharge are characterised by an easily-reproducible spectral energy distribution. Their production is considerably dependent on experimental conditions. The influences of changes in gas pressure, current change, and tube diameter on the total yield of the red neon lines have been measured. Regularities are found which appear to show a dependence of the radiation on the electrical properties of the column. W. R. A.

734. Isotope Effect in the Spectrum of Neon II. H. Nagaoka and T. Mishima. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, Nos*. 536–538. *pp*. 223–231, *Dec*., 1934. *In English*.—Photometric curves of Ne (20) and Ne (22) lines, the tube being viewed transversely, are reproduced. The intensity ratios do not correspond with the relative amounts of the isotopes present. Values of $\delta\nu/\nu$ are given for several lines. The relative intensities of some lines vary with the frequency of the exciting current. Provided that self-reversal can be overcome, wave-lengths of a single isotope of Ne can be used as standards. C. B. A.

735. Spectroscopic Determination of *e/m*. C. D. Shane and F. H. Spedding. *Phys. Rev*. 47. *pp*. 33–37, *Jan*. 1, 1935.—A determination of e/m was made by accurately measuring the difference in wave number between the Hα lines of ordinary and heavy hydrogen. The observations were made with a Fabry and Perot etalon used in conjunction with a spectrograph of sufficient resolving power to separate the interference patterns of the two Hα lines. The effects of the weak fine structure components were eliminated and values of e/m were derived from the two main components. The final mean gives $e/m = 1 \cdot 7579 \pm 0 \cdot 0003 \times 10^7$. From this determination the ratio of the mass of the hydrogen atom to the mass of the electron is found to be $1835 \cdot 6 \pm 0 \cdot 2_5$. There is no indication of systematic errors in the work so that the probable errors may be fairly taken as representing the actual uncertainties in the results. AUTHORS.

736. Fine Structure of Hα. F. H. Spedding, C. D. Shane and N. S. Grace. *Phys. Rev.* 47. *pp.* 38–43, *Jan.* 1, 1935.—The fine structure of Hα was investigated using Fabry and Perot interference patterns produced in the light of ordinary and heavy hydrogen. The auxiliary spectroscopic dispersion was sufficient to separate the patterns of $H^1\alpha$ and $H^2\alpha$. Accurate photometric methods were used in interpreting the spectrograms and a new method of analysing the observed patterns was developed. Following are the principal results: (1) Three components of each line are directly observable, while the two remaining components predicted by theory could not be resolved. (2) The observational evidence indicates definitely the same relative intensities of the components for $H^1\alpha$ and $H^2\alpha$. (3) The relative intensities in so far as they are determined depart markedly from the theoretical values. These departures are consistent with the hypothesis of a diminished population of atoms in the $3D$ energy states. (4) The fine structure constant was determined yielding $1/\alpha = 137 \cdot 4 \pm 0 \cdot 2$. There is some evidence of systematic dependence of this result on conditions of excitation in the source so that the probable error overestimates the accuracy of the result. The correct value probably lies between 137 and 138. AUTHORS.

737. Hyperfine Structure of the Arc Lines of Molybdenum and Copper. L. Sibaiya. *Indian Acad. Sci., Proc.* 1A. *pp.* 321–324. *Nov.,* 1934.—The arc spectra of Cu and Mo are excited in a Schüler hollow-kathode discharge tube and the hyperfine structures of some lines are investigated with a quartz Lummer-Gehrcke plate. Although the lines arising from transitions to the ground state are self-reversed it is found that the positions of the hyperfine structure components can be correctly observed and measured. Six Cu lines are analysed including the two resonance lines. It is confirmed that the two Cu isotopes have each a nuclear spin of $I = 3/2$ and that the m^2D terms exhibit a positive isotope displacement. Six Mo lines involving the ground term exhibited self-reversal, the two component wings being of equal intensity. It is concluded that, if the odd isotopes of Mo have a nuclear moment $I = 1/2$, the separations of the hyperfine structure components must be unobservably small. J. E. K.

738. Hyperfine Structure of Manganese Arc Lines in Vacuo. W. Mohammad and P. N. Sharma. *Phil. Mag.* 18. *pp.* 1144–1149, *Dec.,* 1934.—In extension of the authors' previous work the paper describes observations in the visible region of this spectrum, those in the ultra-violet being reserved for a later paper. For lack of facilities for running a Schüler lamp, which the authors describe as ideal for such an investigation, they continue to use a source similar to that used in their previous work, viz. a 1·5-ampere arc at about 0·1 mm. Hg pressure, the kathode being electrically-heated oxide-coated platinum, and the anode being manganese powder in a silica tube on a nickel rod. The structures of 20 lines, obtained by means of quartz Lummer-Gehrcke plates, are listed and compared with the early (1909 and 1914) observations of Janicki and of W. Mohammad and with the more recent work of White and Ritschl [see Abstract 3446 (1930)]. No interpretation in terms of the hyperfine structure of the atomic energy levels is given. W. J.

739. Nuclear Moments. D. R. Inglis. *Phys. Rev.* 47. *pp.* 84–88, *Jan.* 1, 1935.—The magnetic moments of nuclei, most of them known only roughly, and their more accurately known ratios, can be fairly well explained quantum mechanically on the basis of the following assumptions: Nuclei are built of protons whose spin is 1/2 with a gyromagnetic ratio –5 (the magnitude 5/2 of the magnetic moment agreeing with deflection experiments) and of neutrons whose spin is 1/2 with a gyromagnetic ratio –1·1; according to atomic number and mass at most one of these particles with a possible "orbital" angular momentum exists outside of "closed shells" and in addition possibly two neutrons *without* "orbital" moment. The coupling scheme is selected according to physical considerations analogous to those of atomic theory, and consistent with the importance of the proton-neutron bond. Only states of lowest spin-orbit coupling energy of the proton are realised. AUTHOR.

740. Perturbation of a Hydrogen-Type Atom by a Free Electron. P. Bricout. *Comptes Rendus,* 199. *pp.* 1392–1394, *Dec.* 10, 1934.—The perturbation of the outer electrons of an atom by the electrostatic field of an approaching electron is manifested by the splitting and displacement of spectral lines and by the appearance of a polarisation moment giving place to a potential energy of interaction between the atom and the free electron. This energy is evaluated directly from the wave equation of the perturbed H-type atom, the wave function being developed as a power series, the terms of which correspond to the unperturbed state and polarisation of the atom. N. M. B.

741. Electronic States of N_2^+ and their Energies of Dissociation. H. H. Brons. *K. Akad. Amsterdam, Proc.* 37. 10. *pp.* 793–801, 1934.—Two band systems of N_2^+ are known, Deslandres' negative, $\mathrm{B}^2\Sigma_u^+ \rightarrow \mathrm{X}^2\Sigma_g^+$, and Hopfield's emission system, $\mathrm{C}^2\Sigma_u^+ \rightarrow \mathrm{X}^2\Sigma_g^+$ at λλ1721–2054 [see Abstract 3305 (1934)]. Their analyses locate the $\mathrm{B}^2\Sigma$ and $\mathrm{C}^2\Sigma$ states at 3·15 and 6·67 V above the ground state $\mathrm{X}^2\Sigma$. Besides these three there is another state which is analogous to the $\mathrm{A}^2\Pi$ states of CN, BO and CO. Its existence is established by the perturbations observed in the Deslandres bands; they occur in certain levels of the $\mathrm{B}^2\Sigma$ state and are due to the proximity of certain levels of the ${}^2\Pi$ state, which must therefore be ${}^2\Pi_u$. It is not revealed by a band system; the transitions $\mathrm{C}^2\Sigma_u \rightarrow {}^2\Pi_u$ and $\mathrm{B}^2\Sigma_u \rightarrow {}^2\Pi_u$ are contrary to the selection rule, and the expected system ${}^2\Pi_u \rightarrow \mathrm{X}^2\Sigma_g$ has not been found between λλ2000 and 10,000 Å, and, presumably, lies further in the infra-red. Knowledge of the ${}^2\Pi$ state can at present only be obtained, as in this paper, from a study of the above perturbations. Its position is estimated at about 0·65 V above the ground state $\mathrm{X}^2\Sigma$, and its dissociation energy about 5·15 V, the dissociation energies of $\mathrm{X}^2\Sigma$ and $\mathrm{B}^2\Sigma$ being 6·3 and 3·15 V, and the products of dissociation being the same for these three states, namely unexcited $N(2p^3\ {}^4S)$ + unexcited N^+ $(2p^2\ 3P)$. The dissociation energy and products of the other state $\mathrm{C}^2\Sigma$ are yet unknown. W. J.

742. Emission Spectra of the Vapours of Sodium and Potassium Halides. H. Hamada. *Phil. Mag.* 18. *pp.* 1134–1144, *Dec.*, 1934.—

The emission spectra of NaCl, NaBr, NaI, KCl, KBr and KI are investigated in a discharge tube with a hollow iron kathode in which the halide is vaporised, the pressure being usually about 1 mm. Hg. For the Na halides spectrograms are reproduced in a plate and intensity curves are also given. Each Na halide spectrum consists of: (i) continuum starting near λ4800 in NaCl, λ5300 in NaBr, λ5500 in NaI, and strengthening rapidly to a maximum in each case at the D lines of Na, (ii) the D lines themselves, very strongly developed, (iii) continuum with diffuse vibrational band-structure superposed from the D lines to about λ6550 (observational data are tabulated), and (iv) continuum without band-structure from that point to beyond λ8500 in NaCl, about λ8000 in NaBr, and about λ7700 in NaI. Similarly in each K halide spectrum the continuum rises to a maximum at the " resonance " lines λλ7665, 7699, but no structure has been observed in the continuum on the infra-red side. The observations are discussed and explained with the aid of the *U* : *r* curves for the ground state and three excited states of a Na halide, and are also compared and contrasted to the spectra of the alkali molecules Na_2 and K_2. W. J.

743. Investigations in the Infra-Red Region. Part XI. Absorption Spectrum and Molecular Structure of Boron Trichloride, and the Effect of Strain on Plane Groups of the Type XY_3. A. B. D. Cassie. *Roy. Soc., Proc.* 148A. *pp.* 87–103, *Jan.* 1, 1935.—The infra-red absorption spectrum of BCl_3 has been examined between 1 and 18 μ. Nine bands have been located, but no branch maxima were observed. The observed bands have been correlated with Raman displacements and fundamental frequencies assigned. First and second derivatives of the potential with respect to nuclear separation of the BCl bonds have been evaluated for the equilibrium separation. Morse's potential nuclear separation expression has been used to deduce the true force constant for the BCl bond. The true rigidity of the plane configuration is distinguished from the strain rigidity; both are evaluated, and show that the plane configuration is not due to repulsion of the Cl atoms alone. The electron configuration is discussed. The carbonate and nitrate ions have been similarly investigated with respect to the true force constant and true rigidity. The true force constant shows that bonds of these ions are not localised as in BCl_3; the true rigidity is negative, showing that only repulsion of the oxygen ions maintains the plane configuration. [For Part X see Abstract 2899 (1934).] AUTHOR.

744. Ultra-Violet Absorption Spectra of Alkali Halide Crystals. A. v. Hippel. *Zeits. f. Physik*, 93. 1–2. *pp.* 86–89, *Dec.* 17, 1934.—The alkali bromides and iodides have been shown to possess a double band in the Schumann region [see Abstract 2164 (1930)]. The energy difference in the case of bromides is 0·5 V and of iodides is 1·0 V. CsI shows five bands which can be divided into two pairs having an energy difference of approximately 1·0 V. It is shown that band maxima can be produced on account of the crystallographically different space groups of kations which surround an anion. W. R. A.

745. Ultra-Violet Absorption of Iodine Vapour. D. T. Warren. *Phys. Rev.* 47. *pp.* 1–6, *Jan.* 1, 1935.—The regularity of development of the ultra-violet absorption spectrum of iodine between λ1900 and λ3413 from shorter to longer wave-lengths with increasing temperature and pressure indicates that the bands all belong to one system. The large range of conditions under which bands studied by Pringsheim and Rosen and those found by Kimura and Miyanishi are both found leads to the same conclusion. The " long thin bridge " joining these two regions is explained as the result of the coincidence of $\Delta G' = 70$ cm.$^{-1}$ and $\Delta G'' = 210$ cm^{-1}, causing successive *v'* progressions to coincide. This is supported by the manner in which successive *v'* progressions join on to the single series. A similar explanation probably holds for the single series of spacing 90 cm.$^{-1}$ at the red end of the Pringsheim and Rosen bands, which breaks up near λ2850 into the bands found associated with the λ3413 " continuum " in fluorescence, emission and absorption. This continuum forms the absorption maximum at the long wave-length limit of the spectrum, the red end. It is therefore neither an electron affinity nor ionic recombination nor any other atomic spectrum. These results agree well with Mulliken's theory of this system. AUTHOR.

746. Absorption Spectrum of Arsenic. G. E. Gibson and A. Macfarlane. *Phys. Rev.* 46. *pp.* 1059–1068, *Dec.* 15, 1934.—A new band-system has been found when ultra-violet light is absorbed by arsenic vapour, heated to 1100° C. Some eighty band-heads have been detected between the wave-lengths of 2200 and 2750 Å. An analysis of the vibrational levels has been made, which shows that the spectrum can be ascribed to the diatomic molecule. The value of ω_e is 432 cm.$^{-1}$ for the lower and 271 cm.$^{-1}$ for the upper state. The vibrational levels of the excited molecule are greatly perturbed, as is shown by irregularities in the plot of $\Delta G(v')$ against *v'*. The continuous absorption of arsenic in the ultra-violet is considerable in extent. It is therefore probable that its potential energy curve is cut by another, due to a third state of the molecule, which causes predissociation. Energies of dissociation have been calculated and, by analogy with phosphorus, suggestions have been made as to the states of the atoms produced by dissociation. A doubling of the band-heads in a restricted region of the system has been observed. A critical survey of previous work on the fluorescence spectrum of arsenic is included and an attempt has been made to allot, as far as is possible, vibrational quantum numbers to the bands there observed. AUTHORS.

747. Rotational Structure of the AlCl Bands. W. Holst. *Zeits. f. Physik*, 93. 1–2. *pp.* 55–64, *Dec.* 17, 1934.—For the $^1\Pi \rightarrow {}^1\Sigma$ system of AlCl near λ 2610 Å, the vibrational analysis of which was made by Mahanti and by Bhaduri and Fowler [see Abstracts 2515 and 2904 (1934)], the *v'*, *v''* scheme has been extended by new observations from (9,13) to (10,18), and the rotational analysis has been made for six bands, namely (9,11), (9,12), (9,13) and (10,14), (10,15), (10,16), with a 6·5 m. grating (second order, dispersion 0·96 Å/mm.). The resulting values of the constants are: $^1\Pi$ state: $B_9 = 0{\cdot}195$, $B_{10} = 0{\cdot}202$ cm.$^{-1}$, Λ-type doubling constant $q = 6 \times 10^{-5}$; $^1\Sigma$ state: $B_{11} = 0{\cdot}219$, $\alpha = 0{\cdot}002$ cm.$^{-1}$; the nuclear separation r is therefore of the order 2·3 Å. Predissociation is observed in four bands with $v' = 10$, and from it the dissociation energy of the $^1\Pi$ state is found to be $D' = 0{\cdot}46 \pm 0{\cdot}01$ V. Several diffuse bands between 3000 and 3500 Å probably correspond to transitions beyond this predissociation limit (11,20 and higher). For the $^1\Sigma$ state linear extrapolation of the vibrational energies gives $D'' = 3{\cdot}65$ V. It is concluded that in the ground state $^1\Sigma$ the molecule dissociates into normal Al and Cl atoms, and in the excited state $^1\Pi$ into Al^+ and Cl^- ions. The calculated electron affinity of Cl is 4·45 — 4·31 V. W. J.

748. Vibrational Analysis of the Absorption Spectrum of Lead Sulphide. G. D. Rochester and H. G. Howell. *Roy. Soc., Proc.* 148*A*.

pp. 157–170, *Jan.* 1, 1935.—A new and extensive absorption band spectrum ascribed to the molecule PbS has been discovered in the region λ3140–λ7690. Of 230 bands, 221 have been fitted into six systems. Constants for six of the electronic levels have been found by a least-squares method and are as follows, expressed in cm.$^{-1}$:—

Level	ν_e	ω_e	$\chi_e\omega_e$
E	29650·5	299·34	1·574
D	25024·4	283·95	1·171
C	23212·9	303·93	1·436
B	21847·7	282·17	0·856
A	18851·3	261·09	0·365
X	·0	428·14	1·201

Interesting intensity "anomalies" not explained by the Condon theory have been found in system A. The resolution in the photographs was inadequate to give indications of vibrational isotope effects. AUTHORS.

749. Analysis of Hydrogen Sulphide Band at 10,100 Å. P. C. Cross. *Phys. Rev.* 47. *pp.* 7–14, *Jan.* 1, 1935.—Details of the measurement and procedure of analysis of the $\nu_\sigma + 3\nu_\pi$ band of H_2S are given. An approximate correction for the rotational distortion of the molecule is included. Assignments are made which satisfactorily account for 84 of the 91 measured lines. The remaining 7 lines are considered spurious. The theory for a rigid rotator plus the distortion correction gives a very good approximation to the rotational energy levels of the H_2S molecule, but many deviations are observed which are definitely larger than the experimental error. The moments of inertia in the normal vibrational state are 2·667, 3·076, 5·845 × 10^{-40} gm./cm.^{2}, the axis of least inertia being perpendicular to the symmetry axis of the molecule. The bond angle is 92° 20′ and the H – S distance 1·345 Å. AUTHOR.

750. Comparison of the Spectra of CaH and CaD. W. W. Watson. *Phys. Rev.* 47. *pp.* 27–33, *Jan.* 1, 1935.—The spectrum of calcium deuteride has been photographed at high dispersion with a Ca arc in an atmosphere of heavy hydrogen as a source. Quantum analyses of the B and C systems are presented, and the rotational energy constants and spin doubling of the two states of the B bands are compared with those for CaH. The ratio $B_e{}^i/B_e$ for the ground state is 0·51337 whereas the ratio of the reduced masses is 0·51276. This represents a decrease of 0·059 % for the equilibrium internuclear distance in CaD. The spin doubling in the B $^2\Sigma$ state of CaD does not show the irregular variation with K found in CaH, and is of magnitude almost exactly in the ratio ρ^2 with that of the Λ-doubling in the $A^2\Pi$ state of CaH. Multiple large perturbations occurring in the C $^2\Sigma$ state of CaD are described. AUTHOR.

751. Dissociation and Reformation of Diatomic Molecules. R. Rydberg. *Zeits. f. Physik,* 92. 11–12. *pp.* 693–704, *Dec.* 10, 1934.—The phenomena due to rotational dissociations as observed in bands of the AlH violet system, $A^1\Pi \rightarrow X^1\Sigma$, developed in the Al arc in H_2 at various pressures, are restated. They are discussed both in relation to the "barrier" in the potential curves for the rotational levels of the two vibrational states ($v' = 0$ and 1) of $A^1\Pi$, and also from the standpoint of the law of mass action. Two relevant experimental investigations are described: (i) of the widths of the affected band-lines under high dispersion and the shortened life of the molecule in the rotational levels in question, and (ii) of the variation of the intensity of the AlH lines along a diameter perpendicular to the axis of the arc; in emission the lines are strongest in the core of the arc, and in absorption they are strongest in a region surrounding the core. For the consideration of these phenomena and for the explanation of the observed effects of varying the H_2 pressure, it is assumed that at the high pressures AlH molecules are reformed; theory and observation are in qualitative agreement. W. J.

752. Bond Frequency of Heavy Acetylene C_2D_2. Y. Morino. *Inst. Phys. & Chem. Research, Tokyo, Sci. Papers, Nos.* 536–538. *pp.* 232–234, *Dec.*, 1934. *In English.*—Results of an application of Cross and van Vleck's method to the 4-body problem, as simplified in the case of acetylene, are recorded. They agree, under conditions, with those of Mecke, and good agreement between theory and experiment is obtained for frequencies of C_2H_2 and C_2D_2. The differences in the Raman spectra are shown to be caused only by the mass difference, the force constants being the same for each modification. The vibrations are described, and a Raman frequency 2680 cm^{-1} and an infra-red band at 2408 cm^{-1} are predicted in C_2D_2. C. B. A.

753. Spectroscopic Investigation of the Structure of the Halogen Hydrides. A. K. Dutta and S. C. Deb. *Zeits. f. Physik*, 93. 1–2. *pp.* 127–128, *Dec.* 17, 1934.—The emission spectra of the halogen hydrides consist of continua with definite long wave-length limits. The regions of highest intensity, which are attributed to the normal molecules, do not correspond to dissociation into two normal atoms not into one normal and one excited atom. The binding, therefore, may nor be termed atomic or ionic without qualification. The quantum numbers of all the electrons are determined by the method used by Mulliken and Hund. Two states of different electronic configuration are obtained, one stable and one unstable. The continuum observed can then be predicted. The observed energy relationships can be explained on the London molecular model with repulsive forces, and Slater's atomic dimensions. The electric moments are also discussed. C. B. A.

754. Continuous Band of Glycerin. S. M. Mitra. *Zeits. f. Physik*, 93. 1–2. *pp.* 141–146, *Dec.* 17, 1934.—The spectrum of the fluorescence of pure glycerin excited by Hg λ3650 and by Hg λ3131 consists of a band extending from about 3670 Å to about 4930 Å with an intensity maximum near 4330 Å. This band, the interpretation of which has long been unsettled, is attributed to fluorescence of glycerin itself, and not to impurity or to products of photochemical action of the incident light. With rise of temperature of the glycerin the band becomes less intense but the maximum remains unshifted. The percentage polarisation of the fluorescence is measured for different exciting wave-lengths (3650, 3131 and 2537 Å) and at different temperatures (20° to 60° C.); with rise of temperature it diminishes for each wave-length. The polarisation is the same throughout the extent of the fluorescence band. The effect of addition of a foreign salt (KI) to the glycerin is also investigated. W. J.

755. Zeeman Effect and Magnetic Quenching of the Fluorescence of S_2 and Te_2. I. I. Agarbiceanu. *Comptes Rendus*, 199. *pp.* 1036–1038, *Nov.* 12, 1934.—The quenching of the fluorescence of S_2 and Te_2 vapours in magnetic fields observed by Smoluchowski [see Abstract 4873 (1933)] and Genard [see Abstracts 591 and 2445 (1934)] is attributed to a Zeeman effect and explained. The absorption and fluorescence systems concerned are $^3\Sigma \rightleftarrows {}^3\Sigma$. In a magnetic field the rotational levels of each $^3\Sigma$ state are split into Zeeman or Paschen-Back components, according to the field strength; the results, for $^3\Sigma$, of Hund's theory of these two magnetic splittings in "case *b*" are therefore briefly stated. The fluorescence is partly determined by the absorption lines which are covered by the exciting line. In a magnetic field some components of such an absorption line become covered by different parts of the exciting line and some are uncovered; also, some components of neighbouring absorption lines (not covered by the exciting line without the field) become covered by some parts of the exciting line. The excitation should therefore be different without and with the field, and the fluorescence spectrum should be more complex with the field and should also differ according as the splitting is Zeeman or Paschen-Back. W. J.

756. Stark Effect in the Molecular Hydrogen Spectrum. H. Snell. *Roy. Soc., Phil. Trans.* **234. A.** *pp.* **115-144,** *Feb.*, **1935.**—The intense range of the H_2 spectrum between Hα and Hβ as developed in a modified lo Surdo source is investigated with a stigmatically mounted concave grating (dispersion 3·8 Å/mm.). Nearly all the lines recorded in previously published tables appear on the plates except some faint lines near Hβ. About 350 lines show measurable displacements in a field of 90000 V./cm., while many remain undisplaced. The measured displacements in both polarisations are given to an accuracy of about $\pm 0\cdot1$ cm^{-1}, the largest being about 12·6 cm.$^{-1}$. Results are tabulated for observed lines, both displaced and undisplaced, in bands of four systems with $2s\sigma\,^3\Sigma$, four systems with $2p\pi\,^3\Pi$, nine systems with $2p\sigma\,^1\Sigma$, and three systems with $2p\pi\,^1\Pi$, as their lower states. The observed patterns are compared as far as possible with theory. Lines with low K-values (0 and 1) show simple patterns which agree with theory, and lines with higher K-values show patterns of increasing complexity. Lines with the same initial K-value often have components with equal displacements, but one apparent confliction occurs in the strongest band of all. A few other features are noted. Displacements are also tabulated for more than 100 lines not yet assigned to bands; a few of these lines have not hitherto been recorded. The Stark patterns may assist in future assignments of these lines. W. J.

757. Influence of Stark Effect on Fine Structure of Balmer Lines of Hydrogen. N. P. Heydenburg. *Phys. Rev.* **46.** *pp.* **1069-1075,** *Dec.* **15, 1934.**—In view of the discrepancies reported between the observed and theoretical doublet splitting of the Balmer lines of hydrogen, a detailed study of the Stark effect of the H_α and H_β lines has been made to determine whether small electric fields, which might be present in the discharge tube, could account for the observed results. Calculations have been made for several field strengths using the standard theory of the Stark effect. Doppler curves were plotted for each component and superimposed to give resultant curves. For the H_β line, fields up to 100 V/cm. did not produce a sufficient asymmetry in the doublet components to account for the results of Houston and Hsieh [see Abstract 1592 (1934)]. For a field of 500 volts/cm., H_α has a doublet separation which agrees with that observed by Gibbs and Williams [see Abstract 2032 (1934)]. However, the general shape of the H_β line has changed completely at a field of 400 volts/cm., so that the same field will not account for the doublet separations of all the Balmer lines. AUTHOR.

758. Polarisation and Intensity Measurements in the Raman Spectrum of Carbon Dioxide. A. Langseth and J. R. Nielsen. *Phys. Rev.* **46.** *pp.* **1057-1058,** *Dec.* **15, 1934.**—The relative intensities and the depolarisations (for unpolarised incident light) of the two principal

Raman bands of CO_2 have been measured. The following results were obtained : $\rho_{1286} = 0 \cdot 18$, $\rho_{1389} = 0 \cdot 14$, $I_{1286}/I_{1389} = 0 \cdot 61$. AUTHORS.

759. Relative Intensities of Raman and Rayleigh Lines in Light Scattering. J. Dhar. *Indian Journ. Phys.* 9. *pp.* 189–194, *Nov.*, 1934.—The paper gives an account of measurements on the relative intensities of the Rayleigh and the Raman lines in the scattering by some typical liquids, namely, C_6H_6, CCl_4, $SiCl_4$, $CHCl_3$ and $CHBr_3$. AUTHOR.

760. Fine-Structure of Rayleigh Scattering. B. V. R. Rao. *Indian Acad. Sci., Proc., A. pp.* 261–268, *Nov.*, 1934.—Light scattered in benzene is examined with a Fabry-Perot étalon in the spectral region of the incident lines. The agreement of the displacements of the fine-structure components with the values expected on the basis of Brillouin's theory is good. A. C. M.

761. Rotational Raman Effect in Liquids. A. V. Rao. *Indian Acad. Sci., Proc.* 1*A. pp.* 274–280, *Nov.*, 1934.—The intensity distribution is measured in the rotational wings of lines due to light scattered in benzene, CS_2, cyclohexane, salol, and CCl_4. In all cases there is a large intensity in the neighbourhood of the Rayleigh line, and a feeble but definite extension of the wing far beyond the limit to be expected on the basis of any existing theory. The effect of temperature is observed in the case of several of the liquids, and it is found that the features above mentioned continue to be present, practically unchanged, even at temperatures near to the boiling point. A. C. M.

***762. Discharge-Tube Light Source with Control Characteristics Similar to those of a Thyratron. D. C. Rose.** *Canad. J. of Research,* 11. *pp.* 780–786, *Dec.*, 1934.—Discharge tubes having electrical characteristics similar to those of thyratrons have been used as flashing light sources for recording purposes. The tubes differ from ordinary thyratrons in that the space between the control electrode and anode has been increased, so that the light given out by the intense discharge in this space is available. Two different tubes have been constructed. In the first the anode was placed in a side tube connected to the main tube by a capillary. The discharge through the capillary was used as the light source. An additional electrode was used in the main tube to start the discharge. In the second tube the space between the control electrode and the anode was enclosed by a cylindrical shield having a slit cut in its side through which the light from the discharge passed. These tubes were used successfully for recording the instant that beams of light were interrupted by rifle bullets in a new velocity-measuring apparatus. The tubes have the advantage over usual discharge-tube light sources that they are as easily controlled as a thyratron. Other applications of such tubes as light sources are discussed. [See also Abstract 2759 (1934).] AUTHOR.

***763. Lyman Continuum Tube for High-Dispersion Spectrographs. G. Collins and W. C. Price.** *Rev. Sci. Instruments,* 5. *pp.* 423–425, *Dec.*, 1934.—This ultra-violet continuum, observed by Rathenau to 270 Å, is produced by the instantaneous discharge of a high-capacity condenser through a capillary. It is apparently independent of the gas in the tube and is probably a thermal radiation from hot glass particles torn off the capillary. It has been used by Lyman, Hopfield and others in low-dispersion observations of absorption spectra of gases in this region, but has not hitherto been found suitable for high-dispersion observations, because in the long exposures necessary (several thousand discharges) the bore of the capillary becomes so much enlarged that the continuum falls off for lack of sufficient current density. The construction and method of use of a tube designed for such investigations are here described. It is such that a worn capillary can easily be replaced without greatly disturbing the alignment. It is operated by the non-oscillatory discharge of a 1·5mfd. condenser at 15,000 V., and the continuum is observable to 300 Å. One of the reproduced spectrograms shows Hopfield's strong absorption bands of O_2 at 1000–750 Å, and another shows a newly-observed absorption continuum of He beginning at 505 Å. W. J.

764. New Method for Quantitative Emission Spectrum Analysis. A. Wendt and H. Heun. *Zeits. f. Physik*, 93. 1–2. *pp.* 92–99, *Dec.* 17, 1934.—The spark spectrum of binary alloys of Pb and Sm and of Cd and Zn have been observed visually. The self-induction of the spark was altered so that a spark line of one component appeared equally as bright as a neighbouring arc line of the other component. In a Cd-Zn alloy separation into components was observed to take place on the surface. W. R. A

765. Persistence of Lines Due to Impurities in Iron. R. Breckpot and A. Mevis. *Ann. Soc. Sci. de Bruxelles*, 54. *pp.* 290–298, *Dec.* 17, 1934.—A study of spectra of the iron oxide arc containing traces of Cu, Ba, Pb, Bi, Sn, Sb and As. The best conditions for running the arc are discussed, and results tabulated giving a comparison with previous experiments with Cu. W. R. A.

See also Abstracts 550, 696, 698, 800, 834.

VISION.

766. Structure of Eye Lens in Relation to Star Images. H. Schläpfer. *Naturwiss.* 22. *pp.* 712–713, *Oct.* 19, 1934.—Anatomical investigations of the eye lens have shown a lamellar structure with radial concentric layers. The development of this structure from its most primitive form in vertebrate animals is explained together with increase of accommodation and development of types of cataracts. Similar effects are observed in stars and a similar structure is inferred. R. S. R.

See also Abstracts 653, 919.

X-RAYS.

767. Dispersion of X-Rays by Nickel. Part I. Curve of the Atomic Factor for Nickel. J. Oumanski and W. Wexler. *Phys. Zeits. d. Sowjetunion*, 6. 3. *pp.* 258–267, 1934. *In French.*—The so-called F curve (relating the atomic factor to the angle of dispersion) for nickel is obtained by measuring the diffracted rays with a Geiger counter, and the thermal factor determined from a formula given by Waller and James [see Abstract 940 (1928]. The experimental curve of F thus obtained is compared with the theoretical one derived for Fermi's atomic model and also with that found by Wyckoff, and it is shown that the experimental curve does not fall so quickly as the theoretical one. The discrepancy is taken to be in part experimental and in part due to errors in calculation, since the nickel atom has an incomplete electron shell. G. E. B.

768. Representation of a Series of X-Ray Absorption Curves by a Single Curve. R. Jaeger. *Phys. Zeits.* 36. *pp.* 3–8, *Jan.* 1, 1935.—For heterogeneous X-rays, the absorption coefficient in any filter material is a function of the filter thickness, and falls from an initial, unfiltered value of μ_0, to a value μ_∞ for an infinitely thick filter. Each tube voltage gives a different absorption curve. For any such curve the formula is developed:

$$\log D_0/D = \mu_\infty l + A(1 - e^{-\gamma\mu_\infty l})$$

where l is the filter thickness, and A and γ are constants. If the filter thickness l is replaced by the dimensionless product $\mu_\infty l$, the curves for various voltages can be replaced by a single curve. A series of absorption curves in lead, at voltages from 200 to 400 kV are given, and from these it is shown that for a given value of D_0/D, $\mu_0 l$ is constant for all voltages. A curve showing the relationship between $\frac{\mu}{\mu_\infty}$ and D_0/D is given. The results are tested experimentally, using very hard rays and lead filters, and very soft rays with cellophane. Curves are given showing the relationship between $\frac{\mu}{\rho}$ for various metals to $\frac{\mu}{\rho}$ for carbon, the values being taken from the Landolt-Börnstein tables. In all cases the relationship is linear. It is suggested that, for the materials considered, the absorption coefficients in a given spectral region, are independent of the exciting voltage. J. E. R.

769. Auger Effect in Argon. L. H. Martin, J. C. Bower and T. H. Laby. *Roy. Soc., Proc.* 148A. *pp.* 40–46, *Jan.* 1, 1935.—An investigation of the Auger effect in argon has been carried out with a Wilson expansion chamber. The effect of wave-length of ionising radiation on the probability of internal conversion has been studied for a wave-length range 1·5 Å to 0·2 Å; the probability has been found independent of wave-length. The K yield of argon is found to be 0·077. AUTHORS.

770. Relation between Exposure and Photographic Blackening Produced by X-Rays. E. Hofer. *Zeits. f. wiss. Phot.* 33. *pp.* 198–200, *Dec.*, 1934.—Indicates the manner in which the linearity of the numerical blackening curve for X-rays can be mathematically explained. The equation connecting the number of developable grains and the number of X-ray quanta absorbed is first determined. This is then extended, using a formula given by Arens, Eggert and Heisenberg [see Abstract 2673 (1931)] to show the agreement between the developable thickness and experimental results. The thickness is proportional to the number of radiated quanta, the grain size of the developed silver, and the absorption coefficient for the wave-length in question. R. C. F.

***771. Collectors of X-Rays and Production of Parallel Beams. M. Pierucci.** *N. Cimento,* 11. *pp.* 577–586, *Nov.*, 1934.—If the antikathode of an X-ray tube is placed at one focus of a system of mica paraboloids or ellipsoids, then the X-rays either form a parallel pencil or converge to the second focus. As these surfaces are difficult to produce it is shown, that theoretically, sectors of cones give pencils which are sufficiently intense and uniform. If only 1 % of the incident energy is reflected, then at 2 m. distance the parallel pencil will have the same specific intensity as that of the rays which come directly from the tube and for greater distances their intensity is correspondingly greater than that of the direct rays.
H. M. B.

772. Self-Consistent Field and X-Ray Terms of the Sodium Atom. E. H. Kennard and E. Ramberg. *Phys. Rev.* 46. *pp.* 1034–1040, *Dec.* 15, 1934.—Self-consistent field functions were found for neutral Na, for which they are tabulated, and for the six internally ionised states $1s$, $2p$, $1s2s$, $2p2s$, $1s2p$, $(2p)^2$, these figures denoting in each case the quantum symbols of the missing electrons. With these functions the corresponding atomic energies were computed by the method of Fock and Slater. Applying a first-order correction for relativity and spin-orbit interaction, a close check is obtained between the observed and calculated frequency of Na $K\alpha$, the deviation being of the order of 0·1 %. Finally the energy parameters of the Fock equations were computed to the first order in the exchange for the 2*s* and 2*p* electrons in the singly ionised states and are compared with the corresponding ionisation energies, which they exceed by about 10 %. [See following Abstract.] AUTHORS.

773. Origin of Kα-Satellites. E. H. Kennard and E. Ramberg. *Phys. Rev.* 46. *pp.* 1040–1046, *Dec.* 15, 1934.—The hypothesis, proposed by Druyvesteyn and others, that the $K\alpha$-satellites arise from transitions of a 2*p* ($L_{\text{II, III}}$) electron into the 1*s* (K) shell in the presence of one or two further vacancies in the L shell is tested (1) by comparing in the case of Na the separations from the parent line for the lines due to transitions of the first type calculated by self-consistent field methods with the observed separations of the satellites and (2) by effecting a similar comparison between observation and theory for a number of other elements, the separations being obtained in this case by a simplified method previously used by H. C. Wolfe but extended to include the effects of spin-orbit interaction. It is found that the results can be accounted for if the lines α', α_3 and α_4 are attributed to transitions in atoms lacking one additional electron in the L shell, probably of the type $1s2p \rightarrow (2p)^2$, and the lines α_5, α_6, α_7 and α_8 to transitions in atoms lacking two additional electrons in the L shell. A consideration of the effect of chemical combination supports these conclusions. [See preceding Abstract.] AUTHORS.

774. Structure of the Beryllium K-Line and Conduction Electrons. A. Hautot. *Comptes Rendus*, 199. *pp.* 1399–1401, *Dec.* 10, 1934.—It is shown that the width and intensity of the K-line of Be can be satisfactorily explained on the hypothesis of free electrons, good agreement between theory and experiment being obtained. C. B. A.

***775. Measurement of Absolute X-Ray Intensities and Absolute Sensitivity of X-Ray Film with a Geiger-Müller Counter. G. L. Locher and D. P. LeGalley.** *Phys. Rev.* 46. *pp.* 1047–1051, *Dec.* 15, 1934.—A special Geiger-Müller counter for measuring absolute intensities of X-rays of known wave-lengths is described. The rays pass through the counter in such a way that only electrons set free in the gas of the counter are counted. The absorbing gas column is krypton at 6·31 cm. pressure, 1·08 cm. thick, and 0·0062 cm.^{2} in cross section. For fluorescent Zr K-rays, the absorption in the counter is 3·75 %, as computed on the basis of the energy distribution of the radiation: $K\alpha : K\beta : K\gamma = 0{\cdot}829 : 0{\cdot}154 : 0{\cdot}017$, and absorption coefficients computed from Richtmyer and Warburton's formulæ. A " standard beam " of fluorescent Zr-rays from a specially constructed X-ray tube has been calibrated with the counter. With this beam, the minimum exposure of X-ray film for detectable blackening is found to be about $0{\cdot}72 \times 10^6$ quanta cm.$^{-2}$, incident on the film, or $4{\cdot}1 \times 10^4$ quanta cm^{-2} absorbed in the emulsions (Eastman ultra-speed duplitised X-ray film). The total absorption coefficients of the film, celluloid, and emulsion, for the Zr-rays, are found to be, respectively, 8·63 cm^{-1}, 1·66 cm^{-1} and 13·0 cm^{-1}. Time-blackening curves are given. These show discontinuities at exposures of about 10^7 quanta cm^{-2}. AUTHORS.

See also Abstracts **548, 683, 780, 901, 902–90**

HEAT.

CALORIMETRY.

776. **Calorimetric Behaviour of Metals at Very Low Temperatures. W. H. Keesom.** *Zeits. f. techn. Physik,* 15. 12. *pp.* 515–519; *Disc.,* 519–520, 1934. *Phys. Zeits.* 35. *pp.* 939–943; *Disc.,* 943–944, *Dec.* 1, 1934.—It is shown that at liquid helium temperatures certain metals exhibit a specific heat in excess of that predicted by the Debye T^3 load. This is ascribed to the heat capacity of the free electrons. The calorimetric behaviour of a metal in passing from the supraconducting to the non-supraconducting state is investigated and analysed in the light of thermodynamics. L. G. C.

See also Abstracts 534, 804, 806, 808, 810.

CONDUCTION.

777. **Exchange of Energy between Platinum Surface and Gas Molecules. W. B. Mann.** *Roy. Soc., Proc.* 146. A *pp.* 776–791, *Oct.* 15, 1934.—The accommodation coefficients of Pt wires heated to temperatures ranging up to 1200° C. are studied in atmospheres of He, A, Hg vapour, H_2 and O_2. Results are described showing the dependence of this coefficient on the thermal history of the wire. It is concluded that Pt adsorbs H_2 at 1000° C. O_2 was found to attack the wire at 1000° C., after which the susceptibility of the wire to contamination on lowering the temperature was considerably lessened. R. W. P.

778. **Effect of Magnetic Fields on the Thermal Current in Gases. H. Senftleben and J. Pietzner.** *Zeits. f. techn. Physik,* 15. 12. *pp.* 562–564, 1934. *Phys. Zeits.* 35. *pp.* 986–988, *Dec.* 1, 1934.—The influence of a magnetic field on the thermal conductivity of oxygen is found to be dependent upon the directions of the thermal current and the field, and the regularities of this dependence are now investigated. H. H. Ho.

CONVECTION.

779. **Temperature Field in Air Current Flowing across Hot Cylinder. J. Small.** *Phil. Mag.* 19. *pp.* 21–33, *Jan.,* 1935.—Two mathematical methods are suggested to determine the temperature distribution in air which flows across a hot surface. The temperature field around a steam heated vertical brass cylinder of 4·5 in. dia. is measured by means of a small platinum resistance thermometer. When the air stream is directed at right angles to the axis of the cylinder the measurements indicate that a minimum amount of heat is dissipated from the sides of the cylinder. R. W. P.

See also Abstract 777.

DILATATION.

780. **Thermal Expansion of Solids by X-Ray Method. G. Shinoda.** *Phys. Math. Soc., Japan, Proc.* 16. *pp.* 436–438, *Dec.,* 1934. *In English.*—The thermal expansion coefficients of Pt, Au and W were determined by the X-ray method and the following results were obtained: Pt 9·9 × 10^{-6}, Au 13·2 × 10^{-6}, and W 6·8 × 10^{-6}. AUTHOR.

781. Thermal Expansion of Bismuth Single Crystals Near the Melting Point. J. W. Buchta and A. Goetz. *Phys. Rev.* 46. *pp.* 1092–1095, *Dec.* 15, 1934.—Single crystals of Bi highly purified by repeated crystallisations show no decline in the coefficient of thermal expansion as the melting point is approached. It is shown that the presence of impurities (Pb, Ag, Cd, Sn) in very small amounts does cause the coefficient to decline and attain negative values in a range of 10° or 20° C. below the melting point. On the basis of these observations the discrepancy between previous results by Roberts, and Ho and Goetz concerning the integral (macroscopic) thermal dilatation, and Goetz and Hergenrother, and Jay concerning the lattice expansion of Bi crystals is discussed. AUTHORS.

***782. Recording Dilatometer of High Sensitivity. A. Goetz, J. W. Buchta and T. L. Ho.** *Rev. Sci. Instruments,* 5. *pp.* 428–431, *Dec.,* 1934.—The instrument described was designed to investigate the details of the thermal expansion of crystals over small temperature intervals in order to study certain anomalies such as the nature of the pseudo-allotropic transformation of Bi around 75°, the eutectic melting point of alloyed single crystals, and the dilatations in the regions close to the melting point. The instrument needed (1) a high sensitivity, i.e., an amplification of 10^5–10^6 which should be easily adjustable; (2) a high degree of thermal stability of the actual expansion chamber; (3) an arrangement permitting a reproducible change of temperature with time to almost any degree of slowness in order to avoid the development of thermal gradients due to imperfect isothermal conditions; and (4) self-recording arrangements since such measurements extend over long time intervals. Particulars are given regarding the satisfaction of these requirements and diagrams illustrate the optical and electrical amplification of the instrument, the recording apparatus, the detailed construction, and the mounting of the crystal. The method of calibration is explained. R. S. R.

See also Abstract 574.

MELTING AND BOILING POINTS.

783. Cryoscopy and Association in p-Chlorotoluene. R. P. Bell, E. C. Baughan, and M. W. Vaughan-Jackson. *Chem. Soc., J. pp.* 1969–1972, *Dec.,* 1934.—The cryoscopic constant of purified *p*-chlorotoluene has been determined by an equilibrium method, giving the value 5·53 per mol. of solute per 1000 gm. of solvent. Mono-, di-, and tri-chloroacetic acids were found cryoscopically to be entirely bimolecular in *p*-chlorotoluene over the concentration range 0·05–0·35 mol. per 1000 gm. The molar refractivity of these acids was found to be constant over the same concentration range. AUTHORS.

784. Vitreous State. G. Hägg. *J. Chem. Phys.* 3. *pp.* 42–49, *Jan.,* 1935.—The tendency of glass-forming substances to super-cooling is discussed in connection with the existence of large or irregular groups in the melts of such substances. If the size of these groups makes their direct addition to the crystal lattice difficult, and if the forces within them are so strong as to prevent a rapid disintegration of the groups, the melt will tend to supercooling and glass formation. In the inorganic glasses consisting of oxides of metalloids or the corresponding acids or salts, the formation of large or irregular groups is caused by the strong tendency of these metalloids to coordinate oxygen in a definite way. If the number of available oxygen atoms is smaller than necessary for the formation of discrete polyhedral groups with the required coordination, the polyhedra will be linked together sharing oxygen atoms. The resulting groups will delay crystallisation and thus cause the formation of glass. AUTHOR.

785. Liquefaction by the Cascade Process. W. H. Keesom. *Bull. de l'Inst. Internat. du Froid, June,* 1933. *K. Onnes Lab. Leiden, Nos.* 229–240. *Suppt. No.* 76*a* [20 *pp.*], 1934. *In French.*—It is estimated that the amounts of energy required for the production of 1 kg. of liquid N_2, under a pressure of 1 atmosphere, from the gas at 25° C. and 1 atmosphere by means of (i) the cascade process; (ii) the Linde process, with cycles at high and mean pressures and pre-cooling to −31° C. by aid of an ammonia machine, and (iii) the Claude process, are 463, 894 and 751 k.cal., respectively. The energy losses in the separate stages of the cascade process are analysed in detail. R. W. P.

786. Influence of Air on Condensation of Water Vapour. E. F. M. van der Held. *Physica,* 1. *pp.* 1153–1160, *Dec.,* 1934. *In German.*—A theory is suggested to explain the manner in which the presence of air hinders the condensation of water vapour. This effect is considered to be due to the resistance which an air-rich boundary layer offers to diffusion. The thickness of this layer is shown to be independent of the air content, which is in accord with the experimental results of Othmer. R. W. P.

787. Heats of Sublimation of Organic Molecules. K. L. Wolf and H. G. Trieschmann. *Zeits. f. phys. Chem.* 27. *Abt.B.* 5–6. *pp.* 376–380, 1934.—By the method elaborated by Volmer and others [see Neumann and Völker, Abstract 5102 (1932)] measurements have been made of the heats of sublimation of 15 aromatic compounds and of maleic and fumaric acids and their methyl esters. The results are discussed in relation to the reciprocal influence of polar groups within organic molecules. T. H. P.

See also Abstracts 534, 806, 852.

TEMPERATURE, MEASUREMENT OF.

788. Magnetic Methods for Production of Very Low Temperatures. P. Debye. *Zeits. f. techn. Physik,* 15. 12. *pp.* 499–504; *Disc.,* 504, 1934. *Phys. Zeits.* 35. *pp.* 923–928, *Dec.* 1, 1934.—The recent work of Onnes and Keesom on the production of very low temperatures is briefly reviewed and thermodynamical considerations are applied to the method employing a paramagnetic salt [see Abstract 2103 (1934)]. Temperatures down to 0·018° Abs. are recorded using chrome alum with an initial field of 24,600 gauss. The (magnetic) method of measuring the temperature is described. The difficulties of reaching absolute zero and the possibility of measuring nuclear moments at temperatures approximating to absolute zero are discussed. H. J. H. S.

***789. Temperature Regulator for High Temperatures. J. Förster and E. Gruner.** *Zeits. f. Elektrochem.* 41. *pp.* 9–10, *Jan.,* 1935.—The construction of a temperature regulator for regulating temperatures between 300 and 1000° C. to within 1–2°, and suitable for use with an electrical resistance furnace is described. F. J. B.

See also Abstracts 703, 858.

THERMOCHEMISTRY.

790. Partial Molal Heat of Dilution of Sulphuric Acid from E.M.F. Measurements. I. A. Cowperthwaite and J. Shrawder, Jr. *Am. Chem. Soc., J.* 56. *pp.* 2345–2347, *Nov.,* 1934.—The partial molal heat of dilution of H_2SO_4 was calculated by means of the Gibbs-Helmholtz equation. E.m.f. data of the cell, $\text{Pb-Hg}|\text{PbSO}_4(\text{S})|\text{H}_2\text{SO}_4(\text{m})|\text{H}_2$ were used in the calculation. The results lead to a hump type of curve when the partial molal heat of dilution is plotted against the square root of the concentration. This result is contrary to the results of calorimetric work where linear proportionality was reported. [see Abstract 871 (1935)]. F. J. B.

791. Addition of Symmetrical Diatomic Molecules to Benzene. A. Sherman, C. E. Sun and H. Eyring. *J. Chem. Phys.* 3. *pp.* 49–55, *Jan.*, 1935.—The reaction of hydrogen and benzene to form 1, 2-dihydrobenzene is considered, and the activation energy of the reaction is calculated with various assumptions concerning directed valence,. It is shown that approximate heats of reactions may be calculated by considering exchange integrals only between electrons on neighbouring atoms in a molecule, but this is not possible in calculating activation energies. The hydrogenation of benzene is considered as an eight-electron problem, and the system serves to illustrate the degree of simplification of the secular equation arising from the symmetry of the system. The matrix elements of the factored equation are calculated. Activation energies of the reactions involved in the adsorption of H_2 and C_6H_6 on Ni have been calculated and indicate that the reaction might be achieved more easily catalytically. AUTHORS.

792. Ignition of Hydrogen-Oxygen Mixtures in Glow Discharge. A. K. Brewer and P. D. Kueck. *J. Phys. Chem.* 38. *pp.* 1051–1060, *Nov.*, 1934.—The factors influencing ignition in the positive column are contrasted with those obtained previously in the condensed discharge. Ignition does not occur in the negative glow, the N/H_2^+ ratio remaining almost constant irrespective of the pressure and power input. The results show that the addition of foreign gases lowers the power input for ignition in accordance with the ability of these gases to retard the rate of diffusion ; in the condensed discharge the order is almost the opposite, the work being increased in proportion to the amount of energy absorbed by the gas. The most easily ignited mixture of H_2 and O_2 in the positive column is one containing 25 % H_2 and 75 % O_2. A hyperbolic relation exists between power input for ignition and pressure. The ignitability is increased ninefold for a twofold increase in temperature. It increases with the length of the positive column. It is decreased by the presence of surfaces near the discharge, but is unaffected by surfaces more than about 1 cm. removed. The results are interpreted in the light of the cluster chain hypothesis presented in the preceding paper [see Abstract 5184 (1934)]. The importance of the energy density of the gas surrounding the positive column is estimated by a comparison of the power input for ignition per unit volume of explosive mixture in the positive column and in the condensed discharge. AUTHORS.

See also Abstracts 536, 537, 607.

THERMODYNAMICS.

793. P.V.T. Relations of Single and Composite Gases. G. A. Linhart. *J. Phys. Chem.* 38. *pp.* 1091–1097, *Nov.*, 1934.—This is a continuation of a recent paper [see Abstract 3698 (1933)] ; the equation then suggested $(V_1-V_\infty)/(V-V_\infty) = P^K$, being found equally applicable to single gases and to mixtures of gases over the widest temperature and pressure ranges thus far investigated. Only one constant (K) is involved, which increases with increase in the molecular weight of the gas, but which approaches unity with increase in temperature for all the gases and mixtures studied. R. W. P.

794. Properties of Real Gases on the Basis of the Thermodynamic Equation of State. Part III. Specific Heats C_v and C_p and the Pressure and Expansion Coefficients, α and β, of Helium. W. Jacyna. *Zeits. f. Physik*, 92. 9–10. *pp.* 661–674, *Dec.* 7, 1934.—The simplified equation of state, $vp = R\psi - ap\{10\psi_0 - t(1-11e^{\eta})\}$, where $a = -0{\cdot}0_5 1085$, $\eta = -0{\cdot}0_3 685\sqrt{p\psi}$, $R = 211{\cdot}82$, $\psi_0 = 273{\cdot}22$, has been employed for the calculation of thermal quantities [see Abstract 379 (1935)]: (1) by means of the Scheel and Heuse C_p data for helium whereby the arbitrary constants and function $c(t)$ in the C_v and C_p expressions are determined as, $c(t) = 1{\cdot}2510 + 0{\cdot}1194\,(2 - 5t/\psi)(\psi/100)^{-4}$; (2), $C_p = c\,(t) - 0{\cdot}0_6 112\,p\,e^{\eta}\,(t\eta/\psi + \varsigma\pi_4)$, $C_v = C_p - AR + 0{\cdot}0_8 508p\,(1-11\kappa)$, where $\varsigma = 2-5t/\psi$, $\pi_4 = \lfloor 4\,(1/\lfloor 4 - 1/\lfloor 3\,\eta + 1/\lfloor 2\,\eta^2 - 1/\lfloor 1\,\eta^3 + 1/\eta_4)$, $\kappa = (1 + t\eta/\psi)e^{\eta}$, from which expressions the two quantities C_p and C_v are calculated and expressed in tabular and graphic form; (3) the differences between the two specific heats together with certain thermodynamic properties are explained from the standpoint of the choice therein; the average expansion coefficients are calculated according to the expressions,

$$\alpha = \frac{1}{\psi_o}\left\{1 + \frac{11\,ap\,(1-\kappa)}{R - 10\,ap}\right\} \text{ and } \alpha_m = \frac{1}{\psi_o}\left\{1 + \frac{11\,ap\,(1-e^{\eta})}{R - 10\,ap}\right\}$$

and compared with the experimental data, and (5) verified for transition to the Clapeyron system at $p = 0$. H. H. Ho.

795. Confirmation of the Jacyna Choice Theorem for Helium. W. Jacyna, S. Derewjankin, A. Obnorsky and T. Parfentjew. *Zeits. f. Physik*, 92. 9–10. *pp.* 675–679, *Dec.* 7, 1934.—The choice theorem is confirmed and the van der Waals cohesion loses its earlier significance in that the caloric $C(\Gamma)$ effect (or $(dv/dv)_t$) discovered by Jacyna appears to be negative for helium. The collision hypothesis provides a mechanical model for the Γ or $C\,(\Gamma_v)$ effect. H. H. Ho.

796. Theory of the Equation of State. R. Becker and G. Schweikert. *Zeits. f. Physik*, 92. 9–10. *pp.* 680–689, *Dec.* 7, 1934.—Becker commences by a criticism of Schweikert's theory of the equation of state [see Abstract 4255 (1934)] which he asserts contains a series of errors. In reply, Schweikert states that Becker's criticism is based on fundamental error and misunderstanding. Both authors maintain their respective standpoints in further replies. H. H. Ho.

797. New Types of Phase Change in Homogeneous Substances. E. Justi and M. v. Laue. *Preuss. Akad. Wiss. Berlin, Ber.* 17. *pp.* 237–249, 1934.—A new type of transformation is discussed thermodynamically and considered to be possible, while the type discussed by Ehrenfest [see Abstract 5378 (1933)] is considered to be unrealisable. The experimental evidence is reviewed and some new temperature-time measurements of the transformation of solid O_2 at 44° K. are presented. L. G. C.

798. Phase Transformations of Higher Kinds. A. Eucken. *Zeits. f. techn. Physik*, 15. 12. *pp.* 530–535, 1934. *Phys. Zeits.* 35. *pp.* 954–959, *Dec.* 1, 1934.—It is considered that the extension of the vapour pressure curve above the critical point [see Abstract 4268 (1934)] might be regarded as a phase transformation of the third kind. Reference is also made to a number of low-temperature transformations in the solid state which can be regarded as " disguised " phase changes of the first kind. These are due to changes in molecular structure. R. W. P.

799. Phase Diagram for Mixtures of Many Optional Components. V. Fischer. *Ann. d. Physik,* 21. 4. *pp.* 426–432, *Dec.,* 1934.—A plane orthogonal diagram for mixtures of several components is developed from thermodynamical principles and as an example the equilibrium isobars of a mixture containing N_2-O_2-A-CO are deduced. [See Abstract 4167 (1933).] H. J. H. S.

800. Specific Heat, Entropy and Free Energy of Nitric Oxide from Spectroscopic Data. E. E. Witmer. *Am. Chem. Soc., J.* 56. *pp.* 2229–2233, *Nov.,* 1934.—Values are calculated from 1 to 500° K. from the spectroscopic data and are a correction of the results of Johnston and Chapman whose results contain an error. [See Abstract 1554 (1933).] A. S. C. L.

801. Families of Thermodynamic Equations. Part I. F. O. Koenig. *J. Chem. Phys.* 3. *pp.* 29–35, *Jan.,* 1935.—Attention is called to the fact that certain important equations of thermodynamics such as the two Gibbs-Helmholtz equations may be grouped into families, but that a precise definition of such families has hitherto been lacking. For the case of a single phase of k components in equilibrium a method is given for splitting a certain class of equations, the " f_1^1-equations," into families in a precise manner as follows. The f_1^1-class of equations is defined by means of four " basic " equations and two " basic " assumptions, and involves the $2k + 8$ variables E, H, F, A, V, S, P. T, μ_i, n_i. For the f_1^1-equations there is in turn defined a number of " standard forms " which depend upon the introduction of absolute value signs in a certain way. Then the " characteristic group," a substitution group of the eighth order on the letters E, H, F, A, V, − S, − P, T, μ_i, n_i is generated by a series of geometrical operations on a square. The theorem is stated that the transformation of any f_1^1-equation in standard form by any element of the characteristic group yields an f_1^1-equation in standard form. No formal proof of this theorem is given, but its correctness is sufficiently demonstrated by systematic verification. The theorem leads immediately to the definition of a family of f_1^1-equations as the totality of distinct f_1^1-equations resulting from the transformation of a given f_1^1-equation in standard form by all the elements of the characteristic group. It is found that every f_1^1-equation is a member of one and only one f_1^1-family. The method increases the number of fundamental equations readily available and emphasises the symmetry of these equations. AUTHOR.

802. Entropy and the Absolute Rate of Chemical Reactions. Part I. Steric Factor of Bimolecular Associations. O. K. Rice and H. Gershinowitz. *J. Chem. Phys.* 2. *pp.* 853–861, *Dec.,* 1934.—The equilibrium constant for a bimolecular association may be expressed in terms of the energy change, ΔE, and standard entropy change, ΔS°, on association. On account of the well-known relation between the equilibrium constant, and the rate constants of the bimolecular association and its reverse, the corresponding unimolecular decomposition, the values of these rate constants could be determined separately, if each of the terms, ΔE and ΔS°, could be divided into two parts, in the proper way. The proper method of dividing ΔE is known ; this paper is concerned with the division of ΔS°. Considered from a statistical point of view, the entropy of a system depends upon the volume in phase space available to the system under fixed thermodynamic conditions. The separate rate constants will depend upon the fraction of the phase space in which it is possible for the reaction under consideration to take place. Application of this principle leads to an interpretation of the collision number and the steric factor of bimolecular association reactions. The known bimolecular associations have been discussed from this point of view. AUTHORS.

803. Relation between Molecular Interaction and the Thermodynamic Properties of Solutions. R. P. Bell and O. Gatty. *Phil. Mag.* 19. *pp.* 66–82, *Jan.*, 1935.—This theoretical paper considers the following aspects of the problem : The total contribution of intermolecular forces to the free energy of a mixture and the relation to the perfect gas state ; separation of solvent—solvent and solute—solute interaction and the relation to non-interacting solutions ; comparison of non-interacting and perfect solutions with heat and volume changes ; separation of attractive and repulsive forces, solutions of limited interaction, and the concept of free space ; concept of surface energy and of isochemical solutes for cases when the solute molecules are large compared with those of the solvent and in dilute solutions only. The application of the concept of surface energy to solutions in general and to more concentrated systems, as in Langmuir's theory of mixtures, appears to be open to criticism. H. H. Ho.

See also Abstracts 522, 534, 536, 776, 805, 857.

VAPOUR PRESSURE.

804. Vapour Pressures of Hydrocarbons. Schmitt. *Comptes Rendus,* 199. *pp.* 1299–1301, *Dec.* 3, 1934.—A simple static method is described for the measurement of vapour pressures. Results are given for benzene, toluene, *n*-hexane and methyl-cyclopentane, and values of the latent heat of vaporisation are derived from the Clapeyron equation. R. W. P.

805. Vapour Pressure and Temperature above the Critical Point. J. E. Verschaffelt. *Phys. Zeits.* 35. *pp.* 1013–1014, *Dec.* 15, 1934.—That which Trautz and Ader regard as the continuation of the vapour pressure curve above the critical point [see Abstract 2960 (1934)] is the critical isochor above that point, and is the continuation of the same isochor from below the critical temperature. Above this temperature the volumes of the two phases become imaginary, whereas the equilibrium pressure remains real, so that although the continuation of the vapour pressure curve above the critical point has a real analytical existence it has no physical significance An example is given using the reduced van der Waals equation of state. R. W. P.

806. Vapour Pressures, Melting Points and Chemical Constants of Dimethyl-, Trimethyl- and Isobutyl-Amine. A. Simon and J. Huter. *Zeits. f. Elektrochem.* 41. *pp.* 28–33, *Jan.*, 1935.—The values of the melting points of dimethyl-, trimethyl- and isobutyl-amine are found to be − 93·3° C., − 123·8° C. and − 86·7° C. respectively. Vapour pressures are determined for these substances over the respective temperature ranges − 78·6° C. to 15·4° C., − 90·3° C. to 12·3° C., and − 37·5° C. to 73·8° C. These values are tabulated and represented by empirical equations. That for isobutyl-amine is $\log P = -2278\cdot53/T + 1\cdot75 \log T - 7\cdot7950 \times 10^{-3}T + 7\cdot7890$, which appears to be the first determination for this substance. The latent heats of vaporisation and the chemical constants are also derived. The latter, as deduced from the vapour pressure formulæ, are in fair agreement with those calculated from Trouton's rule. R. W. P.

See also Abstracts 798, 852.

ACOUSTICS.

807. Beat Notes, Combination Tones and Side-Bands. H. Hazel. *Phil Mag.* 19. *pp.* 103–114, *Jan.*, 1935.—Following a brief discussion of the Helmholtz-Koenig controversy and the more recent side-band controversy an account is given of experimental work bearing on these questions. It is shown that there is a difference between beat tones and differential tones. Beat tones, produced by mere addition of frequencies, elicit no response in detecting devices tuned to their frequency. Combinational tones or side-bands have objective existence if peak response in a linear periodic circuit is used as the criterion of existence. These derived frequencies are produced by modulation, which is the multiplication of one periodic disturbance by another. Modulation can be secured either in linear or non-linear circuits. Sound waves do not appreciably modulate one another in air and their sources do not give appreciable modulation even when coupled together mechanically. The Helmholtz-Koenig combinational tone controversy was due to misunderstanding of the conditions for modulation and failure of the experimenters to make their receiving devices independent of the ear. The side-band controversy was based on vague definitions of physical existence and upon the illegitimate use of non-linear elements in detecting apparatus. A. W.

***808. Velocity of Sound in Neon Gas. W. H. Keesom and J. A. van Lammeren.** *K. Onnes Lab. Leiden, Comm. No.* 234*c. Abstract. K. Akad. Amsterdam, Proc.* 3. 79. *pp.* 614–615, 1934. *Physica,* 1. *pp.* 1161–1170, *Dec.*, 1934. *In English.*—The velocity of sound in neon gas has been measured from 0° C. down to liquid neon temperatures. A new vapour cryostat for obtaining the last mentioned temperatures was designed. From the measurements down to liquid oxygen temperatures, making use of values of B (the second virial coefficient) deduced by Cath and K. Onnes, values of C_p/C_v for $p = 0$ were calculated. The results agree within 0·2 % with the expected value 1·667. At the temperatures 27·80 and 26·25° K. the dependence of the velocity of sound on pressure was investigated. The following values were calculated :

T (°K.)	30	40	50	60	70	80
-10^3 B	4·40	2·48	1·55	1·02	0·68	0·46

Values of atomic heats at constant pressure and at constant volume for the temperatures 27·80 and 26·25° K. and pressures from 0 to 1·0 or 0·6 atmosphere respectively were calculated. AUTHORS.

809. H.F. Vibrations of Cylindrical Single Crystals. H. Schoeneck. *Zeits. f. Physik,* 92. 5–6. *pp.* 390–406, *Nov.* 26, 1934.—A previous research [see Abstract 2513 (1932)] on ultrasonic vibrations in polycrystalline metals was extended to single crystals of Zn, Cd and Sn. The speeds of various forms of vibration, as dependent on the shape of the rods, were measured for frequencies which varied from 50 to 1000 kc./sec. In general, with increase of frequency, the speed of transverse waves increases but the speed of longitudinal and torsional vibrations diminishes.

The dispersion of the speed of sound has its cause in the form of the material, and would disappear if the medium were infinite. Qualitatively the dependence of the speed on the frequency is the same in zinc, cadmium and tin. G. E. A.

***810. Excitation of Intramolecular Vibrations in Gases and Gas Mixtures by Collisions, Based on Measurements of Sound Dispersion. A. Eucken and R. Becker.** *Zeits. f. phys. Chem.* 27. *Abt.B.* 3–4. *pp.* 219–262, 1934.—The paper is in two parts. In the first part an apparatus is described for the measurement of ultrasonic wave-lengths, based on the principle of the acoustic interferometer described by Pierce, and which can be also used in investigating chemically-active gases within a temperature range of several hundred degrees. Certain difficulties are dealt with which arise when frequencies of the order of 50 kc./sec. are used. The method of calculation is described by which the values of C_p/C_v at zero pressure for the pure components of a gaseous mixture are determined from the speed of sound in the mixture at a given pressure. In the second part, results are given for the speed of sound and the value of C_p/C_v for Cl_2 and CO_2 for frequencies 58, 145 and 292 kc./sec. It is deduced that the number of collisions required to withdraw a quantum of energy from the pure gases CO_2 and Cl_2 is 51,000 and 34,000 respectively at room-temperature. Under certain conditions these numbers may be greatly reduced. The effect of temperature is such that a rise from $-32°$ to $+145°$ causes a sevenfold increase in pure Cl_2, a four-fold one in CO_2, and in Cl_2 containing CO the increase is five-fold. A formula was derived theoretically, and was found to agree with experiment, according to which the number of impacts required for the release of one quantum is proportional to $1/T^n$ where n is a number depending on two molecular factors. G. E. A.

811. Sound Analysis. E. Meyer and E. Thienhaus. *Zeits. f. techn. Physik,* 15. 12. *pp.* 630–637, 1934.—A method of analysing sounds is described which is claimed to be more speedy than the more usual search-tone method. The sound to be analysed is picked up by a microphone and then used to modulate a 45 kc. current. This is then fed through a suitable high-pass filter from which only the side-band embracing frequencies of 45–50 k.c emerges. This is now used to energise an acoustic radiator consisting of a narrow ribbon in a strong magnetic field. The cylindrical ultrasonic radiation so produced falls upon a concave diffraction grating about 3 m. long and the spectrum obtained is detected with a small condenser microphone the associated amplifier of which is designed not to pass frequencies lying in the audible range. Using the standard definition of resolving power it is calculated that two tones could just be distinguished if their frequencies differed by 125 ∼. This performance could be improved by placing a slit before the microphone. Specimen analyses of pure and complex tones are reproduced. J. E. R. C.

812. Analysis of Vowel Sounds. E. Thienhaus. *Zeits. f. techn. Physik,* 15. 12. *pp.* 637–641, 1934.—The vowels used in German speech have generally four formants. A sound analysis is performed and the articulation and intensity of the vowels is studied in order to construct the vowel circle, which is a schematic representation of the physical and phonetic properties of the series of 15 vowels in use in German. The sound spectra of the semi-vowels and voiced sibilants are very similar to those of the vowels. The conceptions of absolute loudness and relative loudness are discussed. J. E. R. C.

813. Influence of Sound Intensity upon Pitch Perception. O. Vierling. *Zeits. f. techn. Physik,* 15. 12. *pp.* 641–643, 1934.—The author investigates the well-known phenomenon of the apparent change of pitch of a note with its loudness. Two pure tones with a certain intensity ratio are fed alternately to the same loudspeaker and the frequencies of the one adjusted until the apparent pitches are the same. The results are shown graphically and indicate that for 50 db intensity difference an apparent change of pitch of about 5 % is experienced at 200 ~ while at 1,500 ~ it is about 0·5 %. The results are explained by the fact that, in the frequency range considered, of two neighbouring resonators in the basilar membrane, that corresponding to the higher frequency would be the more sensitive; particularly so at low intensities. Thus if the pair were stimulated the sensation corresponding to the higher frequency would predominate more at low than at high intensities. J. E. R. C.

814. Relation of Pitch to Intensity. S. S. Stevens. *Acoustical Soc. of America, J.* 6. *pp.* 150–154, *Jan.*, 1935.—Measurements were made of the amount by which the pitch of tones ranging from 150 to 12,000 ~ is changed by an increase in intensity. Observers were presented alternately with two tones of different frequency and required to make them sound equal in pitch by varying the intensity of one of the tones. The results, when plotted as equal pitch contours, show (1) the pitch of high tones increases with intensity; (2) the pitch of low tones decreases with intensity; (3) the point at which the effect reverses varies with intensity level. The fact that the points of reversal correspond quite closely with the points of greatest sensitivity of the ear, as shown by contours of equal loudness, suggests that the change in pitch with intensity is due to the resonant characteristics of the ear. AUTHOR.

815. Measurement of Noise. A. H. Davis. *Engineering,* 138. *pp.* 663–666, *Dec.* 14, 1934. *Paper read before the British Assoc., Aberdeen, Sept.,* 1934.—The author deals with scales of loudness, and methods employed to measure loudness by " equality " and " masking " tests, and by objective apparatus. The main feature of the paper is a critical examination of the results of various investigators from which the author concludes that objective apparatus of the microphone-amplifier-indicator class can give substantially correct indications of the overall absolute loudness of diverse kinds of noise. [See also Abstract 4277 (1934).] E. J. I.

816. Scales for Noise Measurement. E. J. Abbott. *Acoustical Soc. of America, J.* 6. *pp.* 137–149, *Jan.*, 1935.—An attempt to express sound-pressure measurements in an interference field (such as that due to 2 large power transformers fairly close together) leads either to scientific inconsistencies or practical absurdities or both; data are best expressed in sound-pressure levels. The advantages and disadvantages of various scales for expressing the magnitude of a sound are discussed. At least 8 scales exist, 2 psychological, 6 physical. Three scales seem preferable. As physical scales, the sound-pressure level scale for single notes and frequency analyses, and the weighted sound-pressure level scale for complex sounds, and as a psychological or loudness scale, the loudness-level scale for single notes and frequency analyses and for complex sounds whose loudness is computed by the Fletcher-Munson formula or determined by sound jury, are suggested. The decibel scale seems likely to remain for attenuator calibration, plotting, etc., while for more obvious loudness interpretation, the second scale might well be the Fletcher-Munson, which agrees closely with the Ham and Parkinson, and the Churcher, King and

Davies Scales for ordinary levels, and also represents the best available data for low and high levels. J. E. B.

817. Phonometric Measurements. A. Sellerio. *N. Cimento,* 11. *pp.* 587–602, *Nov.*, 1934.—A simplified technique for carrying out measurements of sound intensity by the method of alternate comparison, is described. Various " change-over " methods for producing " flicker " effects are experimentally examined, and certain phenomena of acoustic hysteresis and attendant irreversible energy dissipation are discussed. J. E. B.

***818. Testing of Absorption Materials. W. Willms and L. Keidel.** *E.N.T.* 11. *pp.* 314–318, *Sept.*, 1934.—In the testing arrangement described an osteo-telephone excited by a heterodyne oscillator communicates its vibrations to a mass m_1, which in turn is coupled by the material under test to another mass m_2 resting on it. The amplitudes of oscillation of each of the masses is electrically recorded, from which the constants of the material may be determined. Several absorption materials are tested in this way, and the values of their damping resistance, elasticity and absorption are tabulated. The absorption is given in terms of the units adopted by Wintergerst and Klupp [see Abstract 2513 (1933)] and by Schmidt. E. T. A. R.

819. Sound Absorption Coefficients. R. N. Ghosh and H. G. Mohamed. *Indian Journ. Phys.* 9. *pp.* 167–178, *Nov.*, 1934.—Coefficients of sound-absorption of a few specimens were determined by the stationary-wave method. The stationary waves were produced in a long clay pipe by a source of sound which was kept in a sound chamber and the sound intensities at different places in the pipe were measured by a movable hot-wire microphone tuned to the frequency of the source of sound (a Numan's oscillator) having a fairly constant frequency and intensity. The specimens tested were: hair-felt, cotton-waste, plaster on bricks, asbestos and khaddar. AUTHORS.

820. Absorption of Sound in Oxygen. H. O. Kneser. *Zeits. f. techn. Physik,* 15. 11. *pp.* 559–560, 1934. *Phys. Zeits.* 35. *pp.* 983–984, *Dec.* 1, 1934.—The excitation of nuclear vibrations by molecular collision in O_2 in thermal equilibrium is briefly discussed. The duration of the vibratory state of the molecule is shown to be obtainable from measurements of the sound absorption in the gas, maximum absorption occurring when the reciprocal of the angular frequency is equal to the average life of the excited state. Measurements in O_2 indicate that the absorption at any one frequency is markedly increased by the presence of small quantities of impurity and by further additions of the impurity may pass through a maximum and decrease again. This is ascribed to the fact that the mean life of the excited molecule decreases as the amount of impurity increases. The resulting dependence of the frequency of maximum absorption upon the concentration of various impurities is investigated. By extrapolating from these results the life of the excited state in pure oxygen appears to be $> 10^{-3}$ sec.; the corresponding frequency of maximum absorption would thus be below 160 ∼. J. E. R. C.

821. Theory of Sound Absorption by Porous Materials. M. Rettinger. *Acoustical Soc. of America, J.* 6. *pp.* 188–191, *Jan.*, 1935.—In a paper discussing the conditions for the ideal sound absorbent [see Abstract 748 (1934)] Gemant, treating only the two extreme cases, one for the very high frequencies and the other for the very low, arrived at unreasonably small values for the absorptivity of porous materials at low frequencies. The problem is here dealt with in a more general manner, and experiments are described on the determination of the flow resistance of porous materials by means of a capillary tube. Results are tabulated for rockwool and for a number of commercial acoustical tiles. A. W.

***822. Sonic Interferometer for Study of Absorption in Liquids. A. L. Quirk and G. D. Rock.** *Rev. Sci. Instruments,* 6. *pp.* 6–7, *Jan.,* 1935.—A description is given of an acoustic interferometer designed for measuring the absorption of supersonic waves in liquids. A quartz crystal in the base of the apparatus serves for generating the supersonic waves and a thin metal diaphragm keeps the crystal from contact with the liquid under test. To ensure a suitable energy transfer the pressure of the crystal on the diaphragm must be adjusted to just the proper value and arrangements are described for effecting this by simple means even while the interferometer is immersed in a temperature controlled bath. The reflector above the diaphragm is of monel metal with an optically flat surface and is carried on the end of the piston by means of a universal joint which allows the reflector to be set parallel to the diaphragm initially by bringing the two into contact. The screw operating the piston is 10 cm. long and is accurately cut, backlash being eliminated by a steel spring arrangement. The length of the chamber can be increased by means of accurately machined extension pieces and in this way measurements can be made over the whole range of distances up to 30 cm. from the source. A. W.

823. Sound Dispersion in Acoustic Filters. E. Grossmann. *Ann. d. Physik,* 21. 4. *pp.* 433–442, *Dec.,* 1934.—In order to test the theory of acoustic filters given in improved form by Waetzmann and Noether [see Abstract 3355 (1932)] the transmission characteristics and dispersions of three different filters were determined for the appropriate frequency ranges. The results obtained were found to be in good agreement with Waetzmann and Noether's theory. A. W.

824. Extraneous Frequencies Generated in Air Carrying Intense Sound Waves. A. L. Thuras, R. T. Jenkins and H. T. O'Neill. *Acoustical Soc. of America, J.* 6. *pp.* 173–180, *Jan.,* 1935.—The theoretical and experimental determinations of the extraneous frequency waves generated in the air within a tube are in good agreement as regards the variation in magnitude with frequency, distance from the source and magnitude of the primary tones. The magnitude of the second harmonic is very nearly proportional to the distance from the source, to the fundamental frequency and to the square of the amplitude of the fundamental pressure. When there are two primary tones, the extraneous frequencies generated in the air include, beside the harmonics of the primary tones, frequencies which are, respectively, the sum and difference of the primary frequencies and also other higher order tones. The magnitudes of the summation and difference tones are very nearly proportional to the distance from the source, to the product of the magnitudes of the two primary pressures, and in each case, to the frequency of the particular combination tone. As regards the absolute magnitudes of the generated tones in the tube, all the measured values are about 3 db lower than the theoretical values. Good agreement was also obtained between the experimental and theoretical determinations of the second harmonic generated in the air within an exponential horn, as regards proportionality to the fundamental frequency and power, and also as to absolute magnitude. In fact, the agreement in absolute magnitude was closer for the horn than for the tube. A. W.

See also Abstract 675.

ELECTRICITY AND MAGNETISM.

ALTERNATING-CURRENT NETWORKS.

*825. **Measurement of Power Factor. R. Witting.** *Zeits. f. techn. Physik*, 15. 12. *pp.* 669–673, 1934.—Describes the adaptation of A. Campbell's well known sifter circuit (in which the secondary e.m.f. of a mutual inductance is balanced against the voltage drop across a condenser in series with the primary winding) for the measurement of power losses in condensers and inductances. The second phase adjustment is obtained by the use of a current or voltage transformer. In the former case the primary winding of the transformer is included in the supply circuit and a voltage tapped off from a potentiometer across the secondary winding is introduced into the detector circuit, while in the latter case the secondary winding is included in the detector circuit and the voltage applied to the primary winding is taken from a potentiometer in the supply circuit. The application to measurements of core losses in iron-cored coils is discussed. Corrections for the phase-angles of the mutual inductance and transformers are applied. N. F. A.

See also Abstract 850.

CONDUCTION AND DISCHARGE IN GASES.

826. **Current-Voltage Characteristics of H.V. D.C. Brush and Glow Discharges in Air at Atmospheric Pressure. J. Zeleny.** *Frank. Inst., J.* 218. *pp.* 685–699, *Dec.*, 1934.—Current-voltage characteristics for h.v. d.c. brush and glow discharges from pointed and spherical electrodes were determined for a wide range of electrode forms and for voltages up to 280 kV. The electrodes varied in size from a needle point up to a sphere 127 mm. in dia.; they were placed opposite a large receiving plane at various distances up to 75 cm. The results obtained are given in a series of families of curves. A. W.

827. **Dependence of the Residual Ionisation Currents in Gases on the Pressure. J. A. Priebsch.** *Zeits. f. Physik*, 93. 1–2. *pp.* 22–34, *Dec.* 17, 1934.—The residual ionisation in a chamber of 4 l. capacity and of the Kolhörster form was determined as a function of the pressure and nature of the contained gas (air, A, CO_2 at 15 atmospheres, H_2 at 5 atmospheres) when the chamber was immersed in water to a depth of 235 m. From the form of the pressure-ionisation curve the effects due to radiation and to residual ionisation can be distinguished. The highest residual current is found with A, that with CO_2 and air being comparatively small. The optimum conditions for the filling of a chamber were deduced from the results. F. C. C.

828. **Conduction of Electricity in Ionised Gases. T. V. Ionescu.** *J. de Physique et le Radium*, 5. *pp.* 578–584, *Nov.*, 1934.—The coefficient of self induction L and the capacity C of a mass of ionised gas is calculated, and the results applied to obtain the natural frequency T of vibration of the gas, using the formula $T = 2\pi\sqrt{LC}$. The action of valves containing ionised gas and having a positive grid potential is discussed. Expressions are obtained for the velocity U of propagation of energy in tubes of ionised gas. Observations are made on the luminous bands in a tube containing gas at low pressure which is placed near a h.f. oscillator. The behaviour

of the stationary waves, as indicated by the bands, shows a variation of U with the capacity and diameter of the tube in agreement with that predicted by calculation. J. E. R. C.

829. Starting of Gas Discharges in Space-Charge Fields. W. Fucks. *Zeits. f. Physik*, 92. 7–8. *pp*. 467–484, *Nov*. 30, 1934.—A discussion is given of the characteristics of gas discharges in the region of small current densities (ignition region) with particular reference to the distortion of the field by space charges. The potential and current density when ignition takes place are calculated as functions of the auxiliary current flowing from the kathode and due to external radiation. A. W.

830. Velocity of the Electrons in the Spray Discharge. H. Fricke. *Zeits. f. Physik*, 92. 11–12. *pp*. 728–740, *Dec*. 10, 1934.—Continuing previous work [see Abstracts 754 and 756 (1934)] on the glow discharge with zero kathode fall of potential (spray discharge), it is found that when an efficient kathode is subjected to a spray discharge, the potential increases as the destruction of the oxide layer proceeds. The life of the sheet is about 70 hours. As free oxygen is formed the destruction is accelerated: the oxygen is detected spectrographically. In hydrogen the sheet has long life if the water formed from the combination of the liberated oxygen is absorbed in P_2O_5. In oxygen the life is only a few minutes while in the rare gases it is shortened by the oxygen liberated from the electrodes and the walls of the discharge tube. The energy of the electrons was 280 volts for a total potential of 300 volts and the energy rose with increasing potential as the discharge proceeded. As the electron velocity increases due to increasing total potential, the general effect observed depends on the granular size of the oxide sheet and on the internal structure of the crystal lattice. F. C. C.

831. Glow-Discharge in High-Velocity Gas Streams. E. Maier. *Zeits. f. Physik*, 93. 1–2. *pp*. 65–85, *Dec*. 17, 1934.—The phenomena of glow discharge in air and in argon have been studied between 4 and 90 mm. of Hg and 0·5 to 6 mA, with longitudinal and transverse gas streams of velocity up to 100 m./sec. It was found that initial induction effects were completely abolished very rapidly and that the extent of burning was influenced by the direction of the gas stream. The constant potential decrease in the positive column is converted by the streaming into an irregular decrease. With air this diminution in potential was greater when the stream flowed to the kathode and less when the stream flowed to the anode than the value obtained with no stream flowing. Gas streamed perpendicularly to the electron path intensified the glow almost proportionally to the streaming velocity. The influence of the gas stream on ions and electrons in the discharge tube and on the electrodes is discussed. W. R. A.

832. Co-Existence of Self-Supporting and Non-Self-Supporting Types of Discharge. W. Kluge. *Zeits. f. techn. Physik*, 15. 12. *pp*. 591–594, 1934.—It is shown that under suitable conditions it is possible to obtain in gas-filled photo-cells both the self-supporting and non-self-supporting discharges at once. The maximal non-self-supporting discharge lies in the transfer region from the Townsend glow discharge to the normal space-charge type of glow discharge. A. W.

833. Sparking Potentials at Low Pressures. S. S. Cerwin. *Phys. Rev*. 46. *pp*. 1054–1056, *Dec*. 15, 1934.—Sparking potentials were observed between outgassed nickel electrodes in air at low pressures. The spark length *d* was varied from 2–10 mm. and the pressure *p* reduced from

1 mm. of mercury to 0·06 mm. Sparking potentials as high as 80,000 volts were observed, and agreed approximately with Paschen's law. The sparking potential V for $p\cdot d < 0\cdot95$ is given by $p\cdot d\cdot e^{V/136,500} = 1$. AUTHOR.

834. Collisions of the Second Kind Between Magnesium and Neon. J. H. Manley and O. S. Duffendack. *Phys. Rev.* 47. *pp.* 56–61, *Jan.* 1, 1935.—The relative intensities of a group of lines in the spectrum of Mg II as excited by a low voltage arc in a mixture of magnesium vapour and neon have been measured at various pressures of neon. Marked effects due to collisions of the second kind between magnesium atoms and neon ions and metastable atoms are found. The ratio of intensities at 2·0 and at 0·017 mm. of neon was taken as a measure of the enhancement or the relative collision cross section for the excitation of the initial level. The results show a decrease of cross section with increase of energy-discrepancy, a finite cross section for exact resonance, and a definite dependence on the L value of the term excited by the collision. Approximate calculation places the cross section at about 10^{-11} cm.^{2} for collisions between neon ions and magnesium atoms. AUTHORS.

***835. Positive and Neutral Rays. Part III. Ionisation by Collision of Atoms. A. Rostagni.** *N. Cimento*, 11. *pp.* 621–634, *Nov.*, 1934.—A description is given of an arrangement for the measurement of the ionisation produced in a gas by bundles of atoms obtained by neutralisation of positive rays. The efficiency is discussed. The results are given of preliminary measurements of the efficacious sections for the ionisation of A and He on the part of the respective atoms, at velocities comprised between 50 and 720 V for the first gas, and between 60 and 460 V for the second. [For Part II see Abstract 2594 (1934).] J. J. S.

***836. Field Combinations for Velocity and Mass Spectrography. Part III. W. Henneberg.** *Ann. d. Physik*, 21. 4. *pp.* 390–404, *Dec.*, 1934.—In continuation of previous work [see Abstract 2986 (1934)] the lens properties of a field combination, comprising a homogeneous magnetic field, a magnetic dipole and an electrical cylindrical field, are deduced. The special case is described in which an electron-optical prism without any lens action is obtained. The most important optical data of the focusing lenses described in the three papers are determined. J. E. K.

837. Formation of Butadiene and Acetylene by H.F. Discharges on Ethylene. A. Balandin, J. Eidus and N. Zalogin. *Comptes Rendus de l'Acad. des Sciences, U.S.S.R.* 4. *pp.* 132–137, *Oct.* 21, 1934. *In German.*—In a closed system, ethylene containing a little hydrogen is completely condensed after 10 hours by the action of h.f. discharges, the gaseous phase containing 67 % hydrogen and 20 % of saturated hydrocarbons (5·3 % methane), and the condensation product being a dark oily liquid of molecular weight about 500. Acetylene was not detected, since it takes part in the reaction. An induction period was observed which is shortened by the presence of water-vapour. In a circulating system at atmospheric pressure, a volume contraction was observed which altered almost linearly with time, and butadiene together with maleic anhydride were formed, the former in amounts dependent on the circulation velocity and partial pressure of hydrogen in the exit gas. The results indicate a chain mechanism for the reactions. H. H. Ho.

838. Chemical Change of Carbon Disulphide under Electrodeless Discharge. M. Emi. *Chem. Soc. Japan, Bull.* 9. *pp.* 442–446, *Oct.*, 1934. *In English.*—The earlier work of Dewar and Jones is confirmed.

Polymerisation products are obtained and no CS stable at room-temperature exists. A. S. C. L.

839. Atomic Bromine. G. M. Schwab. *Zeits. f. phys. Chem.* 27. *Abt.B.* 5–6. *pp.* 452–459, 1934.—Free Br atoms have been produced and spectroscopically identified in discharges at 1/10 mm. pressure. Their recombination outside the discharge is kinetically followed by means of a thermoelement. Recombination ensues with every collision at the vessel wall and is independent of its material—a result in agreement with photochemical experience. Gas reactions of the Br atoms on the latter account could not be carried out in the apparatus described. [See Abstract 4205 (1933).] H. H. Ho.

840. Combination of Hydrogen and Oxygen in D.C. Discharges. E. M. Guénault and R. V. Wheeler. *Chem. Soc., J. pp.* 1895–1901, *Dec.*, 1934.—Experiments are described for measuring the rate of combustion of electrolytic gas at different pressures in a direct current discharge, and the relative temperature changes in the gases through which the discharge is passed. The temperature was found to vary systematically with the experimental conditions (voltage-current-gas pressure, jointly). In comparative experiments with nitrogen, argon, or helium as a diluent, the relative rates of combination of hydrogen and oxygen varied, not according to the effect each diluent gas would have on the degree of ionisation, but with the temperature produced in the mixture by the discharge. It is concluded that combination is not primarily determined by the ionising effect of the discharge but may be materially assisted by the thermal effect. N. M. B.

***841. Quartz Lamp as Ionising Agent. R. Hellmann.** *Zeits. f. Physik*, 91. 7–8. *pp.* 569–572, *Oct.* 12, 1934.—It has long been known that a quartz-mercury-vapour lamp has an unsteady output soon after switching on, but the author shows that some degree of instability persists and probably never disappears. The light output and also the lamp potential were studied oscillographically and it was found that both factors showed quasi-periodic variations having a period of 1 or 2 sec., even after the lamp had been running for 2 hr. The author points out that this defect should be allowed for in work in which the quartz lamp is used to produce ionisation. G. E. B.

***842. Production of Intense Beams of Positive Ions. R. D. Fowler and G. E. Gibson.** *Phys. Rev.* 46. *pp.* 1075–1086, *Dec.* 15, 1934.—The theory of the extraction of intense beams of positive ions from the low voltage arc is discussed, and the development of a requisite apparatus described, with which beams of several milliamperes of ions from H_2, He, N_2 and CO_2 have been produced. The influence of the gas pressure and current density in the arc, and of the extractor voltage and geometry on the density of the beams has been studied. The electrostatic divergence, and the magnetic convergence of the beams is discussed, in connection with the observed spreading. Magnetic analyses of the beams from hydrogen have shown them to consist of H_3^+, H_{3-1}^+, H_{3-2}^+, H_2^+, H_{2-1}^+ and H_1^+, the relative composition being a function of pressure. At a pressure of 27 bars the beams consist almost entirely of H^+_3, and at 96 bars pressure, entirely of protons. Magnetic analyses of the beams from N_2, O_2, and CO_2 have also been made. The secondary emission from a monel target has been measured for H_1^+, H_2^+, H_3^+, He^+, N_2^+, N_{2-1}^+ and CO^+, and found to be 1 to 2 per incident ion in all cases.

The observed target heating has been used as a rough check on the current measurements. AUTHORS.

***843. Resolving Power of Series-Connected Tube Counters. J. N. Hummel.** *Zeits. f. techn. Physik*, 15. 12. *pp*. 573–575, 1934. *Phys. Zeits*. 35. *pp*. 997–999, *Dec*. 1, 1934.—For a given arrangement of capacities and resistances the resolving power of series-connected tube counters depends on the nature of the interior of the counters. The separation of successive coincidences depends on the time occupied by a single discharge. For ordinary air this time cannot be reduced below 3×10^{-3} sec. but by a suitable choice of gas a time of 10^{-3} sec. may be obtained. F. C. C.

***844. Discharge Form in Cylindrical Counters. Part II. S. Werner.** *Zeits. f. Physik*, 92. 11–12. *pp*. 705–727, *Dec*. 10, 1934.—Continuing previous work [see Abstract 4293 (1934)], the dependence of the corona discharge on the pressure was investigated experimentally and the results compared with a formula deduced theoretically. Light-sensitive counters with their kathodes covered with Na behaved anomalously. The instability of the corona discharge is explained on the conception of the period of discharge, the latter being measured by different methods. At the onset-potential the average period was 10^{-6} to 10^{-7} sec. while at the minimum potential it was about 10^{-1} sec. The mean period varies exponentially with the potential. The probability of sparking as a function of the potential is calculated from the period and the results are confirmed by statistical measurements. Experiments with different gases show that the mechanism is the same for all including the rare gases, but detailed quantitative investigations are sometimes difficult. A few technical details are appended. F. C. C.

***845. Portable Geiger-Müller Tube. K. Grant and M. Iliffe.** *Journ. Sci. Instruments*, 12. *pp*. 6–8, Jan., 1935.—Details of a valve circuit are given for a portable Geiger-Müller counter, intended for detecting lost radium tubes. No features of special novelty are claimed, but it incorporates the Medicus corona-tube stabiliser for high tension from an intermittent or variable source, which renders the whole apparatus easily portable. AUTHORS.

***846. Improved Methods of Counting Small Ions. N. Weger.** *Phys. Zeits*. 36. *pp*. 15–20, *Jan*. 1, 1935.—A new method of counting small ions, based on Israël's work [see Abstract 4294 (1931)] is described: the apparatus may also conveniently be used for ionic velocity determinations. Experimental investigation showed that the new ion counter exerted practically zero opposing field on ions entering the apparatus and several sources of error were thereby eliminated. An indirect method of determining the absolute values of the limiting ionic velocities is given. The influence of turbulence is discussed. F. C. C.

See also Abstracts 662, 697, 732, 733, 762, 763, 775, 792, 880, 889, 902.

CONDUCTION IN SOLIDS AND LIQUIDS.

***847. H.V. Voltmeter Based on Electron Optics. E. Fünfer.** *Zeits. f. techn. Physik*, 15. 12. *pp*. 582–584, 1934. *Phys. Zeits*. 35. *pp*. 1006–1008, *Dec*. 1, 1934.—Three possible arrangements for measuring high voltages are discussed. In the first of these the unknown voltage is employed as the anode voltage of a kathode-ray tube with a single pair of deflection plates, the voltage on which is adjusted so that the deflection of the spot on the screen has a predetermined value. The calibration then gives at once the value of the unknown voltage. In the second and third arrangements the unknown voltage is again applied to a kathode-ray tube and the beam is focused either by an electric or a magnetic lens, the voltage in one case and the current in the other case being used to measure the value of the unknown voltage. In an instrument constructed for a range up to about 50 kV a magnetic lens is used. The accuracy of reading depends chiefly on the sharpness of the screen image, but under normal conditions an accuracy of 1 % can be obtained. A. W.

***848. Electrostatic Voltmeter. A. Bestelmeyer.** *Zeits. f. techn. Physik*, 15. 12. *pp.* 661–664, 1934.—A light aluminium needle is suspended by a quartz fibre inside a cylindrical metal box, which is divided longitudinally by parallel cuts into three parts. The two outer parts are connected together and to one terminal of the instrument, while the central portion is connected to the other terminal. The needle is isolated, being connected neither to a terminal nor to any auxiliary source of potential. The instrument thus forms a series-gap air condenser, with a suspended moving plate, which tends to set itself so as to make the capacitance of the instrument as large as possible when voltage is applied. The quartz fibre supplies the controlling force. The shape of the moving vane may be adjusted to give a scale of any desired law. The form for a uniform scale is investigated. The absence of any thin wire or metallic strip suspension has advantages especially at high frequencies. Full scale reading : 20 volts. L. H.

***849. H.F. Electrostatic Pointer Voltmeter. F. Maske.** *Phys. Zeits.* 36. *pp.* 29–31, *Jan.* 1, 1935.—The instrument consists of a " needle " of thin Al sheet with wire suspension, and of a single " quadrant " made of two identical plates between which the needle is attracted when charged. The needle is shaped approximately like a sector of a circle of angle 150° with the middle portion removed. An approximately linear law is thereby secured for all voltages above 10. The dimensions of the needle and quadrant, and of the suspension, are chosen to yield the requisite sensitivity for a period of about 3 sec., and the instrument is made dead beat by magnetic damping effected in the usual way by a metal disc and fixed permanent magnet. At $10^6 \sim$ the impedance is 10^5 ohms and the phase angle 89·9°. and at $10^7 \sim$, 10^4 ohms and 89° respectively. P. V.

***850. Amplifier for Galvanometer Deflections. R. Sewig and W. Appuhn.** *Zeits. f. techn. Physik*, 15. 12. *pp.* 668–669, 1934.—The pointer of the galvanometer carries a small electrode, which is immersed in a column of liquid terminated by two fixed electrodes. Movements of the pointer thus alter the ratio of the resistances of the two portions into which the liquid column is divided by the suspended electrode. These two portions are arranged to form two arms of an a.c. bridge network, the out-of-balance current of which is amplified by a l.f. amplifier and then read by means of a dynamometer instrument, the sensitivity of which is increased by passing a comparatively large auxiliary current through one winding. A small movement of the pointer of the galvanometer thus gives a large deflection of the dynamometer. L. H.

851. Copper-Oxide Rectifier. W. C. van Geel. *Physica*, 1. *pp.* 1143–1152, *Dec.*, 1934. *In German.*—The current flowing through a copper-oxide rectifier may be divided into two parts ; a current due to cold emission, and one due to conductance by the barrier layer. The emission current may be expressed as $i = \mathrm{K}V^{3/2}\mathrm{T}^n e^{-\epsilon\varphi/k\mathrm{T}}$, ($n = \frac{1}{2} \rightarrow 2$), where ϵ is the electron charge, k is Boltzmann's constant, and ϕ is the work

necessary to carry the electron from the Cu_2O layer into the barrier layer. A value of 0·28 volt is found for ϕ. The conduction current may be expressed as $i = \mathrm{V}/[\mathrm{R}_0\, e^{-\Delta \mathrm{W}/k\mathrm{T}}\ (1 + f(\mathrm{V})]$, and tends to saturate with increasing voltage. The value for ΔW, the work necessary to free an electron in the barrier layer, is found to be 0·6 volt. At low voltages $f(\mathrm{V})$ is zero. The constants found for the barrier layer agree well with the corresponding constants for Cu_2O which is free from oxygen.
W. H. W.

***852. Experiments with Liquid Hydrogen. K. Clusius.** *Zeits. f. techn. Physik*, 15. 12. *pp.* 505–506, 1934. *Phys. Zeits.* 35. *pp.* 929–930, *Dec.* 1, 1934.—An arrangement is described by which without the use of He but using liquid H_2 experiments on supraconduction can be exhibited. Further a description is given of an apparatus with which, employing a Dewar vessel, the differences of the vapour pressure and melting point of heavy and light hydrogen are demonstrated.
J. J. S.

853. Resistance of Gold, Copper and Lead at Low Temperatures. W. J. de Haas, J. de Boer and G. J. van den Berg. *K. Onnes Lab. Leiden, Comm. No.* 233*b*. *Physica*, 1. *pp.* 1115–1124, *Dec.*, 1934. *In English.*—The resistance curve of the gold wires measured (not very pure) has a minimum. The copper resistances measured show, that it is impossible to apply Matthiesen's rule for these resistances. The "ideal" resistance of lead calculated (by means of Matthiesen's rule) follows Bloch's formula at low temperature. The transition point of lead is 7·29° K.
AUTHORS.

854. Electric Conductivity at Low Temperatures. R. Peierls. *Phys. Zeits. d. Sowjetunion*, 6. 5. *pp.* 516–519, 1934. *In English.*—In a recent paper [see Abstract 1689 (1934)] Vonsovsky and Smirnov come to the conclusion that the electric conductivity at low temperatures would be proportional to T^{-3}, while the calculations of other authors including Bloch, lead to the T^{-5} law. This note points out that the arguments of Vonsovsky and Smirnov contain an error and that the T^{-5} law is the correct one.
R. L.

855. Supraconduction. A. Papapetrou. *Zeits. f. Physik*, 92. 7–8. *pp.* 513–522, *Nov.* 30, 1934.—A qualitative explanation of the phenomena of supraconduction is possible on the basis of the simple cosine distribution of the energy in the wave number space, if an almost fully occupied energy zone is assumed, and the influence of the thermal oscillations of the lattice is considered. It is suggested that the treatment of supraconduction without the simultaneous treatment of the mechanical problem of the crystal structure of metals is impossible.
J. J. S.

856. Supraconductivity. W. Meissner. *Zeits. f. techn. Physik*, 15.12. *pp.* 507–513. *Disc.*, 513–514, 1934. *Phys. Zeits.* 35. *pp.* 931–937; *Disc.*, 937–938, *Dec.* 1, 1934.—A summary is given of recent work on supraconductivity and on the magnetic effects connected with it. For example, Keesom has found with a small amount of liquid He, well insulated thermally and made to boil at very much reduced pressure, that Al at 1·14° Abs. and Zn at 0·79° Abs. are supraconducting. On the contrary Au at 0·73°, Ag, Mg, W, at 0·74°, Bi, Fe and Ni at 0·75°, Pt at 0·77° Abs., are not yet supraconducting. Various magnetic effects influencing supraconductivity which have been recently investigated are described, such as the fact that if a supraconductor at constant temperature is placed in an increasing magnetic field the supraconductivity disappears at a definite magnitude of the field. The number of the supraconducting electrons is considered. Notes of a discussion on the report and a list of papers on the subjects dealt with are given. J. J. S.

857. Thermodynamics of the Supraconducting State. C. J. Gorter and H. Casimir. *Zeits. f. techn. Physik*, 15. 12. *pp.* 539–542, 1934. *Phys. Zeits.* 35. *pp.* 963–966, *Dec.* 1, 1934.—The supraconducting state is regarded as a two-phase system and reasons are advanced for supposing that the differences between the two phases (supraconducting and normal) are due solely to differences in the respective states of the electrons. At very low temperatures all the electrons are supposed to be in a so-called "crystal-phase," the energy of which is independent of the temperature; while at higher temperatures a certain fraction of the electrons is supposed to be in a so-called "gas-phase," similar to the Sommerfeld electron gas. Simple expressions in accordance with Nernst's theorem being assumed for the energy and entropy of this "gas-phase," an explanation is forthcoming for the observed variations of energy content with temperature. Without additional assumptions as to the structure of the electronic "crystal-phase" it is not possible to explain why the magnetic induction should be zero in the supraconducting state. L. A. W.

858. Electrical Phenomena at Extremely Low Temperatures. J. C. McLennan. *I.E.E., J.* 75. *pp.* 693–709, *Dec.*, 1934.—An account of a lecture dealing with the production and measurement of extremely low temperatures, and describing electrical properties of metals at these temperatures. The lowest temperatures yet attained have been reached by making use of the cooling effect obtainable under certain conditions of demagnetisation. Potassium-chrome alum has in this way yielded a temperature as low as 0·03° K. In dealing with supraconductivity, results are quoted showing the effect of mechanical strains, magnetic fields, the thickness of the metal, and the frequency when a.c. is used. The latter is interesting in that gradual lowering of temperature of Pb produces no discontinuity in the photoelectric effect, or in the absorption of light, from which it appears that supraconductivity is not produced at frequencies exceeding $10^{14} \sim$. For radio frequencies up to $3 \times 10^7 \sim$, however, supraconductivity still occurs. The intervening range of frequencies remains to be investigated. R. W. P.

See also Abstract 554.

DIELECTRICS AND CAPACITANCE.

859. Dielectric Constants of Weakly Polar Crystals and Their Dependence on the Temperature. A. Eucken and A. Büchner. *Zeits. f. phys. Chem.* 27. *Abt.B.* 5–6. *pp.* 321–349, 1934.—The theory of the dielectric constants of solid substances relates mainly to ion crystals of extremely high polarity. Since alkali halides do not completely fulfil this condition, theoretical and experimental results show divergences which are expecially marked for the dependence of the dielectric constant on the temperature. With substances which, from other characters, are regarded as relatively weakly polar, such discrepancies are considerably greater and in some cases theory leads to conclusions which are qualitatively incorrect. For instance, a positive temperature coefficient of the dielectric constant is indicated, whereas negative values are found for TlCl, TlBr and rutile. With the help of curves given by Kirkwood [see Abstract 2741 (1932)] and Bartholomé [see Abstract 5333 (1933)], which show the variability of the dipole moment of two neighbouring (oppositely charged) atoms with increasing separation, a qualitative explanation is obtained both for the high absolute values of the dielectric constants of feebly polar substances and for the varying dependence on the temperature. Values of the dielectric constant at room-temperature, determined by an immersion method, are given for a number of salts. In some cases, the dependence on the temperature was determined between − 190° and + 100° C. T. H. P.

860. Dipole Moments of Monosubstituted Benzenes in the Vapour State. K. B. McAlpine and C. P. Smyth. *J. Chem. Phys.* 3. *pp.* 55–57, *Jan.*, 1935.—The dielectric constants of the vapours of three monosubstituted benzenes have been determined over a range of temperature and used to calculate dipole moments as follows : fluoro-benzene, $1{\cdot}57 \times 10^{-18}$; chlorobenzene, $1{\cdot}70 \times 10^{-18}$; nitrobenzene, $4{\cdot}19 \times 10^{-18}$. These values are considerably higher than those found from previous measurements in solution and agree well with values calculated for the vapour state by the application of an empirical equation developed by Müller to measurements in solution. AUTHORS.

861. Dipole Moment of Heavy Water. F. H. Müller. *Phys. Zeits.* 35. *pp.* 1009–1011, *Dec.* 15, 1934.—The dielectric constants of ordinary and heavy water were measured. The values of the dipole moments are respectively $1{\cdot}76$ and $1{\cdot}78 \times 10^{-18}$. W. R. A.

862. Interpretation of the Dielectric Constant. D. L. Webster. *Am. Phys. Teacher,* 2. *pp.* 149–151, *Dec.*, 1934.—The introduction of the dielectric constant in elementary courses, in the equation for the forces between charged bodies in fluid dielectrics, has led to its use in two ways : first, for comparing different dielectrics ; and second, for specifying the dimensions and numerical values in several fundamental equations, including Maxwell's. These two uses appeared closely related when material dielectrics were supposed to " weaken the ether," and this law then appeared fundamental. Now, however, the force on a charged body in oil is known to be not purely electrostatic, but partly molecular. The author therefore advocates changes in instruction : first, removing this composite force from the fundamental place it has been given ; second, introducing electrostatics through forces between bodies *in vacuo* only, with a " constant of electrostatics " like that of gravitation and just as constant ; and third, introducing dielectrics through condensers, in which the specific inductive capacity appears quite simply. AUTHOR.

863. Motion in Dielectric Liquids Caused by Electric Fields. R. Hofmann. *Zeits. f. Physik,* 92. 11–12. *pp.* 759–795, *Dec.* 10, 1934.—Investigation was made of the phenomenon observed when a fluid dielectric is subjected to a strong direct or alternating electric field. When the field exceeds a certain amount, depending on the kind of liquid and the experimental arrangements, a motion of the surface is observed which can rise to intense bubbling of the whole liquid. The streak method of Toepler was employed in the experiments and the objective used was placed on an optical bench close to the vessel containing the liquid examined in which were electrodes at which a high voltage was produced. When a small inequality of density occurs in the vessel of liquid the effect of the streaks produced in causing deflection in a ray of light traversing the liquid can be observed and the interior of the liquid thus examined. The surface of the liquid was also observed in obliquely incident light. The velocity of the waves observed on application of the voltage was determined and an influence on the conductivity established. The chief experiments were made with toluene. It was found that the currents made visible by cooling of the electrode have their origin almost entirely at the electrode surface. The current itself arises from migration of a wave-front which moves parallel to the electrode. It is noted that the electrically moved liquid brings free charge with itself and that therefore the direction of current helps in determining the field formation. As explanation for the mechanical motion the dipole character of the liquid is accepted. J. J. S.

See also Abstracts 539, 576, 723, 758, 825.

ELECTROCHEMISTRY.

864. Electrolysis of Copper into Rock-Salt. S. Arzybyšev and U. Parfianovič. *Comptes Rendus de l' Acad. des Sciences, U.S.S.R.* 4. *pp.* 25–30, *Oct.* 11, 1934. *In German.*—The transport of Cu ions in rock-salt was investigated. A crystal of rock-salt, 2 × 1·2 × 0·6 cm., was clamped between two copper plates. Contact was secured by including a fine copper net between the copper plates and the crystal. The arrangement was heated in an electric furnace to 648° C. The penetration of the copper into the rock-salt was followed by the coloured bands produced by driving in metallic Na. Preliminary experiments gave the velocity of diffusion of copper into rock-salt as $15 \cdot 6 \times 10^{-3}$ mm./sec. at 648° C. [See Abstract 561 (1935).] F. J. B.

865. Electrolytic Oxidation. Formation of Hydrogen Peroxide by Electrolysis with a Glow-Discharge Anode. S. Glasstone and A. Hickling. *Chem. Soc., J. pp.* 1772–1773, *Nov.*, 1934.—Electrolysis of dilute H_2SO_4 and later solutions of other electrolytes under conditions in which glow discharge could take place, resulted in the formation of H_2O_2. The formation was considered to take place by the union of the OH radicals formed at the surface of the electrolyte by the discharged OH ions. The possibility of the formation of H_2O_2 by secondary reactions is considered to be remote. F. J. B.

866. Glow Discharge Electrolysis. A. Klemenc and T. Kantor. *Zeits. f. phys. Chem.* 27. *Abt.B.* 5–6. *pp.* 359–375, 1934.—The electrochemical oxidation reactions of the glow discharge electrolysis (G.D.E.) of aqueous H_2SO_4 are to be attributed mostly to the decomposition of water vapour at the anode and kathode and, indeed, solely to the atomic H formed (about 15 % of the total quantity being utilised), which produces $H_2S_2O_8$ and H_2O_2. In this respect polar H differs from apolar, the H separating at solid kathodes not showing such reactions. This points to the influence of the electrode, in which a solution of the polar H is to be assumed. In G.D.E. polar O is not able to oxidise, but since it oxidises at solid electrodes, the latter must have a special catalytic action. No persulphate is formed from sulphates on G.D.E.; this is directly opposed to the behaviour at solid electrodes (wall electrolysis) but corresponds with expectation. The formation of H_2O_2 here observed is a recombination of two hydroxyls. The current localised at the glow point furnishes energy which is taken up by the water molecules present, these then governing the whole chemical behaviour of the glow current. [See Abstract 5423 (1933).] T. H. P.

***867. Kathodic Polarisation of Metal Electrodes. I. Zlotowski.** *Acad. Polonaise Sci. et Lettres, Bull.* 3–4*A. pp.* 115–160, *March–April,* 1934. *In English.*—An instrument was devised for the periodic and continual renewal of solid metal electrodes, and a polarograph for the study of kathodic polarisation of solid metal electrodes was elaborated. By means of these devices over-potentials of Zn, Cd and Pb, and the current-voltage curves due to electrodeposition of hydrogen on renewed and non-renewed metallic electrodes were investigated. F. J. B.

***868. Measurement of Overvoltage by Means of an Electromagnetic Interrupter and an Oscillograph. A. L. Ferguson and G. M. Chen.** *J. Phys. Chem.* 38. *pp.* 1117–1125, *Nov.*, 1934.—An electromagnetic interrupter is described which makes it possible to open the charging circuit at any desired time interval after charging is started. With this interrupter and accompanying alterations in the oscillograph it is possible to superimpose curves representing various types of potentials as determined by the direct method, and to interrupt the charging circuit at the same point on the film for each. Owing to the lag in the vibrating element, the drop in potential over a pure resistance does not appear vertical. Because of the great lag when the vibrating element has returned nearly to its zero point, it is not possible to distinguish between depolarisation and an IR drop when the polarisation is less than about 5 mV. No curves that represent the potential between an electrode and its own reference electrode, *i.e.*, that contain no known IR drop, show any indication of an IR drop due to surface resistance. This work substantiates the conclusion arrived at in several earlier papers from this laboratory, that there is no transfer or surface resistance at platinised Pt electrodes in 2 *N* H_2SO_4. [See Abstract 376 (1933).] AUTHORS.

869. Glass Electrode Study of Chromic Acid. J. D. Neuss and W. Rieman. *Am. Chem. Soc., J.* 56. *pp.* 2238–2243, *Nov.*, 1934.—H-ion activity has been measured in solutions of chromic acid and of the chromates by means of the glass electrode. The second ionisation constant of chromic acid is $3 \cdot 20 \times 10^{-7}$. The equilibrium constant of the reaction $Cr_2O_7^{-} + H_2O \rightleftarrows 2HCrO_4^{-}$ is 0·023. A. S. C. L.

870. Platinum Electrode Potentials in Alkaline Sugar Solutions. J. M. Ort and M. H. Roepke. *J. Phys. Chem.* 38. *pp.* 1061–1074, *Nov.*, 1934.—The behaviour of Pt electrodes in alkaline sugar solutions was investigated. The pH of the solutions did not exceed 10·5. Evidence was obtained that an oxygenated derivative of glucose was adsorbed on the surface of smooth Pt electrodes and prevented them from acquiring the oxidation-reduction potentials characteristic of the concentrations and natures of the oxidants and reductants in the mildly alkaline glucose solutions. This adsorption is believed to account for the recognised variability of the potentials on such electrodes. F. J. B.

871. Activity Coefficients of Sulphuric Acid from 0–50° C. J. Shrawder, Jr., and I. A. Cowperthwaite. *Am. Chem. Soc., J.* 56. *pp.* 2340–2345, *Nov.*, 1934.—The e.m.f. of the cell $|Pb\text{-}Hg\ (2\ phase)|\ PbSO_4(S)\,|H_2SO_4(m)|H_2|$ was measured. The concentrations of the H_2SO_4 were 0·02, 0·01, 0·005, 0·002 and 0·001 M, and the measurements were made for each dilution at 0°, 12·5°, 25°, 37·5° and 50° C. A method of extrapolating to infinite dilution is devised in which account is taken of the incomplete dissociation of the bisulphate ion. The activity coefficient of H_2SO_4 is calculated for each temperature for the five dilutions. [See Abstract 790 (1935).] F. J. B.

872. Normal Electrode Potentials. J. Shrawder, Jr., I. A. Cowperthwaite and V. K. La Mer. *Am. Chem. Soc., J.* 56. *p.* 2348, *Nov.*, 1934.—Several revised normal electrode potentials are obtained by combining data already published. The results are employed to construct a table for E at 25° C.:—(Pb-Hg (two phase), $PbSO_4(S)$, SO_4^{--}), 0·3505 V; (Hg, $Hg_2SO_4(S)$, SO_4^{--}), − 0·6141 V; (Zn Hg (two phase), Zn^{++}), + 0·7614 V; (Zn, Zn^{++}), + 0·7620 V; (Cd-Hg (two phase), Cd^{++}), + 0·3519 V; (Cd, Cd^{++}), + 0·4024 V. F. J. B.

873. Applicability of Nernst's Electrochemical Law to Very Dilute Solutions: Normal Potentials of Bismuth and Polonium. M. Haïssinsky. *Comptes Rendus*, 199. *pp.* 1397–1399, *Dec.* 10, 1934.—With the radioactive isotopes, RaE and ThC, as indicators, the critical potentials of solutions of $Bi(NO_3)_3$, $10^{-5} - 10^{-10}N$ in Bi, (in $0 \cdot 5 - 1 \cdot 8N -$ HNO_3), have been determined, whence, assuming Nernst's law to be applicable, the normal potential of Bi/Bi^{III} is deduced as 0·226, separate results showing good agreement. With the same assumption for the very dilute solutions of polonium available, the normal potentials of Po/Po^{IV} and Po/Po^{III} are respectively 0·775 ± 0·015 and 0·53 ± 0·03 [see Abstract 4132 (1934)]. C. A. S.

874. Discharge Potential of Barium Sulphate. H. R. Kruyt and R. Ruyssen. *K. Akad. Amsterdam, Proc.* 37. 9. *pp.* 624–632, 1934. *In French.*—Reference is made to Julien's results on the change of sign of the contact potential for crystals of different sizes and to the effect of absorption at the surface. Measurements were made with samples of natural and precipitated $BaSO_4$. It was found that (1) the discharge potential of $BaSO_4$ is a function of the development of the crystal surfaces; (2) crystals of $BaSO_4$ with feeble surface development retain a negative charge even in the presence of $BaCl_2$ and the curve ζ/C for potential/concentration is analogous to that for paraffin. Values of ζ are lowered uniformly by surface conduction; (3) precipitated $BaSO_4$, when the grain size is about 10μ, shows in pure water a feeble but slight negative charge. It is charged positively by weak concentrations of $BaCl_2$, and negatively by the soluble sulphates, the curves of ζ/C being almost symmetrical in the two series; and (4) the chlorides of the bivalent metals Sr, Ca, Mg, Zn and Cd give to it a positive potential while those of the alkali metals (Na and K) increase the negative potential of the surface layer. R. S. R.

875. Anti-Corrosive Action of Gelatin. G. Lejeune. *Comptes Rendus*, 199. *pp.* 1396–1397, *Dec.* 10, 1934.—The anti-corrosive action of gelatin at varying temperatures (50–100°) was examined for iron plates immersed in N–$FeSO_4$ containing 10 % H_2SO_4, to which 0·5–2 % gelatin had been added. Within these limits the relative diminution in corrosion increases rapidly with temperature, but is almost independent of the amount of gelatin. It is attributed to increased over-voltage caused by the gelatin, which raises the discharge potential of the H-ions, and so diminishes the polarisation of the metal, opposes discharge of H-ions, and hinders passage into solution of Fe'' ions. C. A. S.

876. Electrochemical Potential of Iron and Corrosion. N. Nekrassow, I. Stern and Z. Gulanskaja. *Zeits. f. Elektrochem.* 41. *pp.* 2–9, *Jan.*, 1935.—The electrochemical potential of iron was investigated in aqueous solutions of Na_2SO_4, $NaHCO_3$, Na_2CO_3, NaCl, sodium phosphate, acetate and oxalate. It was found that when the potential of iron was displaced towards the negative, or hydrogen side, the velocity of corrosion was increased, a displacement towards the positive or oxygen side was accompanied by a reduction in corrosion velocity. The dependence of the changes of potential and the velocity of corrosion upon the pH values was determined. The combined influence of pH values and various anions (phosphate, chlorate, etc.) on the potential and the velocity of corrosion was investigated. F. J. B.

877. Electrochemistry of Magnesium. S. Bodforss and H. Kajmer. *Zeits. f. phys. Chem.* 171. *Abt.A.* 3–4. *pp.* 190–198, 1934.—The electrolytic potential of Mg in buffer solutions has been investigated with specially pure preparations of the metal. The pH —, anion- and movement-effects previously noted are shown in varying degree. Stirring causes a parallel displacement of the potential curves always in the same direction, evidently as a result of reaction of the metal with the solution. The alterations in potential caused by addition of fluoride, ammonium salts, and pyrocatechol have been investigated. The velocity with which magnesium dissolves in buffer solutions is exactly proportional to the time and, for each buffer, is proportional to the content in acid and almost independent of the ratio of acid to salt. This velocity increases in the order: citric, malonic, succinic, acetic and formic acids, and is approximately proportional to the dissociation constants of the acids corrected for the statistical factor. These results are in agreement with those of Kilpatrik and Rushton (*J. Phys. Chem.* 34. *p.* 2180, 1930, and 38. *p.* 269, 1934) whose experiments are discussed. [See Abstract 2514 (1931).] T. H. P.

***878. Exact Method for Measuring Kathode Current Distribution. E. Mantzell.** *Zeits. f. Elektrochem.* 41. *pp.* 10–20, *Jan.*, 1935.—An exact method of measuring the current distribution on a kathode was developed. The measuring kathode consisted of an ebonite plate bearing 10 copper strips 240 × 10 × 2mm. separated from each other by 1 mm. By means of this kathode, the current distribution was measured under several different conditions of electrolyte, distance between electrodes and size of anode. F. J. B.

See also Abstracts **533**, **544**, **790**.

ELECTRONS, POSITRONS AND PROTONS, INCLUDING APPLICATIONS.

879. Classical Analogy to Electron Spin. W. Wessel. *Zeits. f. Physik,* 92. 5–6. *pp.* 407-424, *Nov.* 26, 1934.—The equations of motion in classical electron theory are transformed in such a way as to make them comparable with those of Dirac's electron theory. A classical analogy to the spin variable is drawn from this comparison. J. E. R. C.

880. Experiments with Artificially Produced Positrons. E. Rupp. *Zeits. f. Physik,* 92. 7–8. *pp.* 485–512, *Nov.* 30, 1934, and 93. 3-4. *p.* 278, *Jan.* 4, 1935. *Zeits. f. techn. Physik,* 15. 12. *pp.* 575–579, 1934. *Phys. Zeits.* 35. *pp.* 999–1003, *Dec.* 1, 1934.—The artificial source of positrons was produced by a fastbeam of protons of about 300 kV energy, incident on a thin Li-sheet situated in an Al hemisphere. Detection was provided by expansion chamber and by photographic plate. A few positrons were obtained from Mg and Be but none from Cu, Hg or Au. The energy spectrum of the positrons from Al, obtained by use of a magnetic field, showed a broad maximum at about 800 kV. and an upper limit at about 2500 kV. The charge and mass of the positron was found to equal that of the electron to within 5 %, but in passage through foils of Al and Au the former showed only continuous scattering in contrast to electrons of the same energy. The ratio of elastic to inelastic scattering is smaller for positrons by a factor of 10. The absorption coefficient in Al, Cu and Au was smaller by 30 %, and was approximately proportional to the atomic weight. Impact of positrons on all substances gave an intense X-radiation having a mass absorption coefficient $\mu/\rho = 0{\cdot}18 \pm 0{\cdot}08$ cm.²/gm. The yield of the radiation was about 200 % of the positron intensity. The positron radiation does not cease immediately the proton beam is cut off and closer investigation shows the existence of two components due to the presence of radio-nitrogen and radio-aluminium respectively. F. C. C.

881. New Determination of the Elementary Electric Charge. E. Schopper. *Zeits. f. Physik*, 93. 1–2. *pp.* 1–21, *Dec.* 17, 1934.—The charge on a single α-particle is determined by counting the number of α-particles emitted by a Po source and measuring the total charge given up to an electrometer. Recoil atoms were retained on the source by covering the latter with a thin film of thermally vaporised Ni. The magnitude of the elementary electric charge was determined to be $(4{\cdot}768 \pm 0{\cdot}005) \times 10^{-10}$ e.s.u. with a probable error of 1 %. F. C. C.

882. Experimental Determination of Electronic Densities. J. Solomon. *Comptes Rendus*, 199. *pp.* 1296–1297, *Dec.* 3, 1934.—A method, based on Born's theory of electronic impacts, is suggested for determining electronic densities in substances. The necessary formula, valid outside the range $\lambda/4\pi$ from the nucleus (λ denoting the wave-length appropriate to the mass and velocity of the incident electron) is derived. The expression for the law of force between the electron and the centre of diffusion is also derived. J. S. G. T.

***883. Camera for Electron Diffraction. J. A. Darbyshire and E. R. Cooper.** *Journ. Sci. Instruments*, 12. *pp.* 10–14, *Jan.*, 1935.—Complete details are given of a camera designed to enable a wide range of experiments on electron diffraction to be carried out. The apparatus is suitable both for reflection and transmission and also any general type of rotation of the specimen examined. AUTHORS.

884. Diffraction of β-Rays. J. V. Hughes. *Phil. Mag.* 19. *pp.* 129–145, *Jan.*, 1935.—In the experiment described de Broglie's law has been verified, to an accuracy of 5 % for electrons with energies ranging from 250 to 1000 kV. Thus de Broglie's law has now been verified for electrons over the whole range from 50 volts to 10^6 volts. These high velocity electrons were β-rays, a monochromatic beam being selected by a magnetic field of original design which at the same time focussed a beam of considerable angle. Even then exposures of the order of days were necessary with sources of 50 to 100 mc. of Rn. The diffracting coils used were sputtered gold or gelatin. AUTHOR.

885. Formation of Electron-Optical Images with Photoelectrons. J. Pohl. *Zeits. f. techn. Physik*, 15. 12. *pp.* 579–581, 1934. *Phys. Zeits.* 35. *pp.* 1003–1005, *Dec.* 1, 1934.—An electron microscope with magnetic focusing is applied to the production of images of photo-kathodes. With a specific photoelectric emission of 10^{-7} to 10^{-6} A/cm.², a one-hundredfold magnification and a 30-kV acceleration of the electron beam, an image of a photo-kathode is obtained which can be photographed in about 5 sec. The photoelectron images of various surfaces are compared with corresponding light images and a general similarity between the two types of image is noticeable. The apparatus is applied to an investigation of the influence of gas-content and crystal structure on the geometrical distribution of the photoelectronic and thermoelectronic emission from a platinum surface. J. E. K.

886. Attainment of High Resolving Power with the Electron-Optical Immersion Objective. E. Brüche and W. Knecht. *Zeits. f. Physik*, 92. 7–8. *pp.* 462–466, *Nov.* 30, 1934.—Experiments are described which were directed to the attainment of the highest possible resolving power with the electron-optical immersion objective described originally by Johannson [see Abstract 297 (1934)]. Decreasing the electron-lens aperture from 1 mm. to 0·2 mm. was found to give no increase in resolving power. The main obstacle to increased resolution was traced to an insufficient fineness of detail in the objects under investigation. The necessary fineness was eventually obtained by evaporation of barium on to a nickel surface; the barium was deposited in the form of tiny spherical particles from whose diameters and separations it was concluded that a resolving power of $1\cdot5\mu$ could easily be obtained with the 1 mm. aperture lens. This compares with the maximum resolving power of $0\cdot4\mu$ of the magnetic electron microscope. J. E. K.

887. Geometrical Electron Optics. E. Brüche and M. v. Ardenne. *Zeits. f. Physik*, 92. 11–12. *pp.* 815–827, *Dec.* 10, 1934.—Brüche criticises certain statements made by v. Ardenne in two recent papers [see Abstracts 1270 and 2139 (1934)]. It is stated that the conditions for a magnetic diverging lens do not satisfy the fundamental hypotheses and reasons are given to show that such a lens could not be used in an achromatic combination. The same remarks apply to the electrostatic diverging lens suggested by v. Ardenne. The behaviour of the lens systems employed by v. Ardenne in a high vacuum oscillograph is criticised on the basis that two important factors are neglected. It is pointed out that the method of rendering visible the ray paths in an oscillograph and the method employed in examining its performance are not original. In reply, v. Ardenne adduced evidence to show that the work is original. He enlarged on certain features of his papers and showed that the omission of the two factors mentioned is permissible under certain conditions. Brüche retorts that v. Ardenne's work is of little importance in practice for the principles of Gaussian dioptrics are violated. H. J. H. S.

***888. Theory of Electron Gun. I. G. Maloff and D. W. Epstein.** *I.R.E., Proc.* 22. *pp.* 1386–1411, *Dec.*, 1934.—The function of the electron gun, irrespective of the purpose for which the kathode tube is used, is to generate, to concentrate, to control, and to focus an electron beam to a spot of a desired size. This paper describes the theory of the above-mentioned functions. The point of view of electron optics is presented and the theory of thick electron lenses with variable indices of refraction is given. A somewhat detailed analysis of the action of the various parts of the gun is given, using the concepts of electron optics whenever convenient. Then a relevant part of thermionic emission is treated, with an emphasis on the distribution of velocities of emission. The initial concentration in the proximity of the kathode, the control of the beam intensity, and the effects of space charge are presented next. In closing, the performance of the gun as a whole is given, and a mathematical and graphical design procedure, made possible by certain assumptions and approximations, is described. AUTHORS.

***889. Photographic Blackening Due to Very Slow Electrons. O. Meier.** *Phys. Zeits.* 36. *pp.* 8–14, *Jan.* 1, 1935.—Previous workers have found it impossible to obtain blackening of a photographic plate with electrons of energy less than about 20 volts. This was thought to be due to the fact that the electronic energy was insufficient to excite the photographic materials. A detailed description is given of an apparatus in which electrons of low energy are fired in a semicircular path on to a photographic plate. Down to 5 volts, photographic blackening is observed. It is suggested that this limit is due to the inability of the apparatus to project sufficient electrons on to the plate at this voltage, and not to the photographic inefficiency of the electrons. J. E. R.

890. Ratio of Blackening with Internal and External Films in Recording Kathode-Ray Oscillographs. E. W. Freisewinkel. *Arch. f. Elektrot.* 28. *pp.* 826–832, *Dec.* 12, 1934.—A comparison was made of the blackening obtained in a recording kathode-ray oscillograph using (*a*) roll films behind a zinc sulphide (ZnSCu) screen and (*b*) "zellon" foil of thickness 16μ. The connection between the degree of blackening and the energy of the kathode beam was investigated for a considerable energy range. The results obtained are shown graphically. Under the conditions employed the combination of roll film and ZnSCu screen was found to be the better for ray voltages below 55 kV. For ray voltages of about 70 kV the zellon foil gave appreciably greater blackening than the roll film and ZnSCu screen when the blackening was slight, but as the blackening increased the two processes gave results more nearly equal. [See also Abstract 5179 (1934).] A .W.

See also Abstracts 527, 548, 555, 665, 677, 716, 735, 844, 847, 926, 932.

ELECTROSTATICS.

891. Electrification of Dust Particles Blown by Air Blast. U. Nakaya and T. Terada. *Phil. Mag.* 19. *pp.* 115–123, *Jan.*, 1935.—Measurements were made of the charge of individual dust particles by the microscopic method used by Ladenburg. By the method of Millikan's oil-drop experiment the mode of charging up of an initially uncharged particle of dust in an atmosphere ionised by a point discharge or α-rays was investigated. In the deflection experiments under the microscope particles were blown out of a jet and caused to pass through a space between two electrode plates connected to the terminals of a transformer. The electric field applied was 60 cycles and 3000 V/cm. In experiments made to determine the sign the positive and negative particles were separated by a direct electric field. The substances used in the tests were coal dust, resin powder and lycopodium powder. The authors conclude that the charge of dust particles is chiefly produced by a natural friction between them, and consequently the particles blown out by an air blast consist of positive and negative particles mixed together. An important factor in the phenomenon is the abundance of either the total positive or negative charge which is proper to the material of the dust in an algebraic sense. J. J. S.

See also Abstracts 848, 849.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

892. Hall Effect of Cuprous Oxide. O. v. Auwers. *Zeits. f. Physik,* 93. 1–2. *pp.* 90–91, *Dec.* 17, 1934.—It has been pointed out by Gudden [see Abstract 4299 (1934)] that the Hall effect of cuprous oxide is anomalous and positive. Previous work by the author is repeated and the new observations contradict his previous results and agree with those of Gudden. W. R. A.

893. Application of Thermo-Mechanical Principles to Conductors. J. E. Verschaffelt. *Comptes Rendus,* 199. *pp.* 836–838, *Oct.* 29, 1934.—Expressions are derived for the Thomson and Peltier e.m.f.s in an isotropic conductor, and for the Bridgman and Kelvin-Borélius effects in anisotropic conductors. In cases where the anisotropy is produced by a magnetic field expressions are given for the Ettingshausen and Nernst effects. R. W. P.

See also Abstracts 788, 856, 933.

MAGNETISM AND ELECTROMAGNETISM.

894. Electromagnetism Independent of Metrical Geometry. Parts I–IV. D. van Dantzig. *K. Akad. Amsterdam, Proc.* 37. 8. *pp.* 521–531; 37. 9. *pp.* 643–652, and 37. 10. *pp.* 825–836, 1934.—It is shown that Maxwell's electromagnetic equations can be put in a form in which they are independent of the metric of space. The linking equations then provide a tensor-density of rank four which characterises matter and also gives the coefficients of the metric in empty space. Invariants can also be found whose variations give Maxwell's equations, whatever the metric. The equations of motion of a charged particle moving in an electromagnetic field can also be shown to be independent of the metric of space. These equations are reducible to the fact that the vector of momentum and energy is constant in the sense of the Lie-derivative during the motion. The Lie-derivative is a derivative independent of the connection of space. It follows that mass is to be considered as a type of electromagnetic interaction-energy. In Part IV, using the unified field theory thus developed, the author shows how the theory gives an integral relation between the second-rank tensor of stress, momentum and energy, and the vector of momentum and energy, so that Planck's law, $E = h\nu$, can be worked into the scheme. The result is found by consideration of plane-polarised monochromatic light waves. [See Abstract 5240 (1934).] G. C. McV.

895. Equations of Motion for a General System of Two Particles. W. H. Watson. *Phil. Mag.* 19. *pp.* 124–128, *Jan.*, 1935.—The author considers that the idea of the electromagnetic field and the laws of electricity serve merely to calculate the dynamical interactions in the system of objects participating in an electrodynamical phenomenon. The conservation of energy and momentum need not be retained. The essence of the motion of a field acting on a particle is that it connects different orbits of the particle in it. It is, therefore, a property of a system of orbits. This point of view of the electromagnetic field was recently explained, and in the present paper the method is extended to the case of two particles. J. J. S.

896. Ferromagnetism and Small Field Changes. H. Jordan. *Ann. d. Physik,* 21. 4. *pp.* 405–425, *Dec.*, 1934.—Two recent papers by Gans and Wittke [see Abstracts 836, 837 and 3415 (1934)] are discussed. Further attempts are made to account for the discrepancies between theory and practice and certain statements made by the authors are criticised. **R. Gans** replies. H. J. H. S.

897. Matteucci Effect. F. v. Schmoller. *Zeits. f. Physik,* 93. 1–2. *pp.* 35–51, *Dec.* 17, 1934.—Investigations described in a previous paper [see Abstract 777 (1933)] were continued. The Matteucci effect—e.m.f. at the ends of a twisted ferromagnetic wire on change of magnetisation—exhibits two phases of opposite sign with the same sign of the change of magnetisation. Both are explained as induction of a circular component of magnetisation. Tension and torsion processes give effects of different sign. The effects are localised on the steep and flat portions of the magnetisation curve. On the static curve the point can be determined at which the irreversibility perceptibly disappears. The dependence on torsion of both effects was examined, and the angular determination of the position of the elementary moments carried out with rectangular loops of nickel. J. J. S.

898. Unsymmetrical Rectangular Loops with Circular Magnetisation. F. v. Schmoller. *Zeits. f. Physik*, 93. 1–2. *pp.* 52–54, *Dec.* 17, 1934.—Rectangular loops of nickel obtained by torsion show on circular magnetisation a horizontal displacement. Upon the magnetisation vector inclined under 45° to the axis of the wire there act, with different sign of the longitudinal but the same sign of the circular field, different-turning moments. J. J. S.

***899. Magnetic Researches on Co-Pd System. G. Grube and O. Winkler.** *Zeits. f. Elektrochem.* 41. *pp.* 52–60, *Jan.*, 1935.—A magnetometer suitable for thermomagnetic measurements is described. It is applied to a study of the phase changes in pure Co and in alloys of up to 90 atomic % Pd. The transformation temperatures and Curie points are determined and a phase diagram is deduced. In pure Co and in the alloys containing 5 and 10 atomic % Pd an irreversible transformation occurs which is similar to that observed in the Fe-Ni alloys. The Curie points decrease in a regular manner as the % of Pd increases. The presence of a series of β- solid solutions is suggested in alloys containing up to 90 atomic % Pd. H. J. H. S

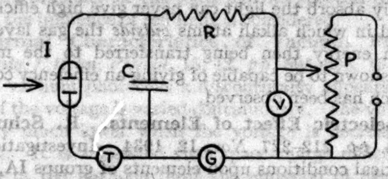
***900. Measurement of Curie Points at Low Temperatures. R. Forrer and V. Marian.** *J. de Physique et le Radium*, 5. *pp.* 617–618, *Dec.*, 1934.—Describes a simple method for measuring Curie points from very low temperatures up to 400° C., based on the change in deflection of a magnetometer acted on by a small permanent magnet when the test-specimen is placed across its poles. Magnet and specimen are in close contact with a bulb thermometer and the variation of magnetometer deflection with temperature is observed when the temperature is changed slowly. To avoid a variable zero due to a direct temperature effect on the magnet, a symmetrical magnet having 3 poles is arranged to produce no magnetometer deflection until the specimen is placed across two of its poles. Provided the specimen is small the deflection is shown to be proportional to the intensity of magnetisation in it and accurate extrapolation of the steep part of the curve to give the true Curie point is possible. C. E. W.

See also Abstracts 554, 577, 601, 602, 715, 778, 788, 858, 868.

MEDICAL RADIOLOGY AND ELECTROLOGY.

***901. Manufacture and Properties of X-Ray Film. H. A. Edgerton.** *Brit. J. of Radiology*, 7. *pp.* 767–773; *Disc.*, 773–774, *Dec.*, 1934.—The density produced on a photographic film exposed behind an aluminium wedge is studied with and without intensifying screens, and the density is plotted against the thickness of the aluminium or the anti-log. of the thickness. In the absence of screens, the shape of the curve depends on the intensity of the radiation, but with screens the curve showing the variation of density with aluminium thickness is nearly linear, and the slope is a function of kilovoltage only. The influence of stale developer on density is examined and it is shown that it reduces contrast, as well as requiring a longer time to produce the same density. G. E. B.

***902. Instrument for the Measurement of Ionising Radiations. T. A. Chalmers.** *Brit. J. of Radiology*, 7. *pp.* 755–763, *Dec.*, 1934.—This instrument is somewhat similar to the normal Geiger counter, but has been simplified in the interests of portability and robustness. The discharge chamber consists of an " Osglim " lamp which is connected (see figure) through a suitable resistance R (*ca.* 0·5 megohm) to a suitable p.d. supplied by the potentiometer P. The condenser C has a capacity of 0·05 to 0·1 μF. T is a pair of telephones and G a long-period microammeter. The intensity of the radiation is measured by counting the discharges in the telephone in the case of weak radiations, or by observations of the microammeter in the case of more intense beams. G. E. B.



See also Abstracts 667, 768, 770, 841, 845, 919.

OSCILLATIONS.

903. Theory of Kipp Oscillations. F. Klutke. *Zeits. f. techn. Physik*, 15. 12. *pp.* 622–624, 1934.—In this preliminary paper, the author, using linear differential equations having rapidly-varying variable coefficients, advances a theory which seeks to unify two externally quite different phenomena. As representative of the two groups, choice falls on the periodic charge and discharge of the condenser in the Kipp relaxation-oscillation (" blinker ") circuit, and the more or less sinusoidal oscillations generated by a valve oscillator. J. E. B.

***904. Radio-Frequency H.V. Generator. D. H. Sloan.** *Phys. Rev.* 47. *pp.* 62–71, *Jan.* 1, 1935.—A large radio oscillator with unrectified alternating anode power-supply sends h.f. power into a 50 m. wave-length aerial which is coiled up without insulation and enclosed in a metal vacuum tank. Over 800,000 V is generated inside the tank exactly where it is to be used for X-rays or for accelerating ions. There is no insulation to become punctured. Single tuned-circuit resonance transformers are superior to coupled tuned-circuit Tesla coils. Resonance transformers, oscillator circuits, power valves, power supply and coil construction are described. X-ray production, and ion acceleration are outlined. AUTHOR.

***905. Automatically-Regulated Precision H.V. Source. O. H. A. Schmitt.** *Rev. Sci. Instruments*, 5. *pp.* 435–437, *Dec.*, 1934.—It is frequently desirable to generate very steady h.v. d.c. from l.v. a.c. obtained from a source subject to violent fluctuation. An instrument is described which will maintain output voltage constant to less than 1 % so long as the supply voltage remains in the range between 95 and 165 V. The variation of output voltage with changes in applied load is 0·1 % per mA. The pure d.c. output may be varied easily and reproducibly between 100 and 2200 V. AUTHOR.

See also Abstracts 762, 828, 851, 926.

PHOTOELECTRICITY.

906. Theories of the Spectral Selective Photoelectric Effect. C. Zener. *Phys. Rev.* 47. *pp.* 15–16, *Jan.* 1, 1935.—Clean alkali surfaces emit less than one photoelectron for every 10,000 incident light quanta in the visible spectrum. A monomolecular layer of gas can greatly increase this yield. In this paper it is shown that mechanisms in which the metal electrons directly absorb the light can never give high efficiencies. A process is discussed in which alkali atoms *outside* the gas layer absorb light, their excitation energy then being transferred to the metal electrons. This process is shown to be capable of giving an efficiency comparable with the highest which has been observed. AUTHOR.

907. Photoelectric Effect of Elements. R. Schulze. *Zeits. f. Physik*, 92. 3–4. *pp.* 212–227, *Nov.* 12, 1934.—Investigations are carried out under identical conditions upon elements of groups IA, IIA, IVA, IB, IIB, IIIB and the first long period (K to Kr) of the periodic table. Using a double monochromator, the long-wave photoelectric limit is determined directly as the wave-length at which a rate of incidence of energy of 10 ergs per sec. no longer produces a current of 10^{-15} ampere. A parallelism is observed between the long-wave limit and the series limit of the free atoms as deduced from ionisation potentials. Measurements are also carried out upon the photoelectric yield as function of the wave-length. This is found to be constant for each sub-group of the periodic table, but to vary greatly throughout a long period. L. A. W.

908. External Photoelectric Effect of Compound Kathodes at Low Temperatures. R. Suhrmann and D. Demster. *Zeits. f. techn. Physik*, 15. 12. *pp.* 549–551, 1934. *Phys. Zeits.* 35. *pp.* 973–975, *Dec.* 1, 1934.—The term " compound " is used to describe kathodes consisting of a film of an alkali metal (here potassium) in a state of atomic division separated from a conducting plate (here solid potassium) by an extremely thin layer of a substance such as potassium hydride or naphthalene. When cells with compound kathodes are cooled to liquid-air temperature it is found that irradiation with light of the wave-length of the longer-wave maximum causes a lowering of the sensitivity at the longer-wave maximum, the effect being independent of whether a current is taken from the cell or not. This observation is explained as due to the excitation of absorbing centres. According to this view the process of photoelectric emission at ordinary temperatures involves three steps, absorption by the centres, transference of the excitation energy to neighbouring electrons by thermal collision and finally consequent ejection of the electrons from the kathode. At low temperatures the energy transference by collision does not occur and the lifetime of the excited state is lengthened to several hours. It is observed that the excited state can be terminated by irradiation with red light with production of an electron current. A short quantitative treatment is given. L. A. W.

909. External Photoelectric Effect in the Case of Cuprous Oxide. E. Wasser. *Phys. Zeits. d. Sowjetunion*, 6. 3. *pp.* 351–367, 1934. *In German.*—The characteristics of the external photoelectric effect shown by Cu_2O, a typical semi-conductor, in air and hydrogen, are investigated experimentally. The long wave-length limit at which the effect occurs is 258$\mu\mu$. The relation between applied voltage and maximum velocity of the electrons follows a linear law similar to Einstein's but the results yield too low a value for Planck's quantum of action. This discrepancy is interpreted by postulating the existence of a blocking layer on the surface of the oxide. J. S. G. T.

910. Photoelectric Effect in Cuprous Oxide. I. K. Kikoin. *Phys. Zeits. d. Sowjetunion,* 6. 5. *pp.* 478–489, 1934. *In German.*—Further details are given of experiments on this subject [see Abstract 3431 (1934)] The effect of the intensity of the light and its spectral distribution were examined, and the influence of red light is considered. J. J. S.

***911. Abnormal Characteristics of Vacuum Photocells. H. Geffcken.** *Zeits. f. techn. Physik,* 15. 12. *pp.* 595–598, 1934.—It is found that in certain vacuum photocells a discontinuity appears in the current-voltage curve if the voltage is varied continuously. The voltage at which it appears is very much lower when the voltage is decreasing than when it is increasing. It is suggested that space-charge effects in the microscopic crevices in the kathode limit the emission of electrons from the inside of these crevices, and that this restraint is removed when the ionisation of the very small amount of residual gas in the cell reaches a certain critical value. This conclusion is supported by the results of an experiment and by certain details of the behaviour of the cell. By allowing a very small amount of gas to remain in cells of this type the primary photoelectric current can be considerably increased, as the ionisation is then sufficiently great at low voltages to prevent this limitation of the emission of photoelectrons. The amount of gas required is so small that the cell can still be classed as a vacuum cell. D. H. F.

***912. Action of Ions in Gas-Filled Photocells. H. Richter.** *Zeits. f. techn. Physik,* 15. 12. *pp.* 598–601, 1934.—Experiments were carried out with a special cell, with the anode in grid form, and with an extra electrode, on the further side of the anode from the kathode, which collects most of the ions produced by the gas-magnification. Liberation of electrons from the kathode by ion-bombardment is thus reduced, and it is found that the anode potential at which the glow-discharge sets in is considerably higher than when this auxiliary electrode is not used. The maximum output from the cell is thereby increased, in spite of the loss to the auxiliary electrode. D. H. F.

913. Loss and Restoration of Photoconductivity in Red Mercuric Iodide. F. C. Nix. *Phys. Rev.* 47. *pp.* 72–78, *Jan.* 1, 1935.—Single crystals of red mercuric iodide, which normally display photosensitivity when precipitated, lose their photosensitivity on ageing. This loss is accompanied by a change from the mono- to the polycrystalline fibrous state with considerable randomness of orientation of the individual crystallites. The non-sensitive crystals can be resensitised by subjecting them to an electric field for a time of the order of a few minutes. The increase in photosensitivity is accompanied by a decrease in the dark current. These correlated phenomena may not occur till after the lapse of an appreciable time after the field is first applied. The rate of decrease of the dark current with time is greater the lower the temperature. The data also suggest, but do not conclusively demonstrate, that the dark current increases with decreasing temperature. The rate of resensitisation and the magnitude of the attained photosensitivity are found to increase with (*a*) increase in applied field strength, and (*b*) decrease in temperature. When the light is turned on the photoelectric current is found, under certain circumstances, to rise briefly to a maximum and then descend to a permanent value at which the total current is equal to the value of the dark current prevailing when the voltage was first applied. AUTHOR.

914. Selenium Rectifier Photocells under High Illuminations. G. Liandrat. *Comptes Rendus*, 199. *pp.* 1394–1395, *Dec.* 10, 1934.—It is suggested that the apparent variation in sensitivity of Se rectifier photocells under high illuminations [see Abstract 1360 (1934)] are due to variations in the conductivity of the rectifying layer, and arguments are advanced in support of this. It is found that the effects are reduced to about 2–3 % by using a filter which absorbs red and infra-red rays. It is suggested that reducing the thickness of the Se layer would further reduce the effects; and that work in the musical range of frequencies offers the best means of determining what methods of preparation would lead to the production of a cell without a rectifying action. D. H. F.

***915. Deposition of Selenium Cells. L. W. Jones.** *J.O.S.A.* 25. *pp.* 1–3, *Jan.*, 1935.—When Se cells are deposited in O_2 and CO_2 the variations of resistance with depositing temperature are similar to the variations of resistance with temperature of Se, with a minimum at 164° C., due to change of crystal structure with temperature. The resistances of cells deposited in CO_2 are much higher than of those deposited in O_2. Baked Pt paint gives a grid of very low contact resistance. $CaCl_2$ drying caps improve the cells. W. H. W.

***916. Rectifier Photocells. Cécile Roy-Pochon.** *Soc. Franç. Élect., Bull.* 4. *pp.* 1199–1210, *Dec.*, 1934.—This paper gives a general account of the "rectifier" type of photocell. Special stress is laid on the fact that, in the author's experience, it is possible to make cells of this type without rectifying properties, and it is suggested that a less objectionable name for this class of photocell would be "photovoltaic cell." The working of both the Se and the Cu_2O types is described; the current-intensity characteristics, temperature effects (from which the non-rectifying cells are free), colour sensitivity, the response to modulated light and the difficulties of amplification are discussed. Finally, the method of preparation is outlined, and the applications of the cells enumerated. D. H. F.

***917. Response of Rectifier Cell to Light Fluctuations at Audio-Frequencies. J. H. Roe.** *Rev. Sci. Instruments*, 5. *pp.* 441–445, *Dec.*, 1934.—Describes apparatus designed to enable the illumination falling on a rectifier cell to be varied sinusoidally at frequencies up to 10,000 ∼. The maximum intensity was 100 foot-candles covering an area of 1¼ sq. in. The cell was connected in series with a condenser of 20 mfd. across an amplifier shunted by a resistance and a variable inductance. The variation of response was plotted over the range of frequencies 12 to 7000 per sec. It was found that the curve became flatter as the load impedance was decreased but this effect could only be obtained with a sacrifice of output voltage. J. W. T. W.

***918. Theory of Barrier Layer Cells. R. H. Varian.** *Phys. Rev.* 46. *pp.* 1051–1054, *Dec.* 15, 1934.—It is shown that the theory of the photovoltaic effect developed by Frenkel and Joffe [*Phys. Zeits. d. Sowjetunion*, 1. 1. (1932)] is incomplete because it contains no adequate explanation of the direction of flow of the current. The proper direction of current flow follows as a natural consequence if the great difference in rate of energy loss by photoelectrons in the semiconductor and the metal is taken into account. In the metal collisions between photoelectrons and conduction electrons are frequent, and transfer of energy is rapid, whereas in the semiconductor such collisions are infrequent, and transfer of energy by elastic collisions of a photoelectron with atoms is slow. Hence rapidly moving photoelectrons tend to migrate into the metal and there lose their energy and become trapped. AUTHOR.

919. Light-Sensitive Systems. J. Eggert. *Zeits. f. techn. Physik*, 15. 11. *pp.* 436–443, 1934.—This is a general account dealing with the properties (especially quantum yield and spectral distribution of sensitivity) of photographic layers, photoelectric cells and photochemical devices for estimating dosage of ultra-violet radiation for medical purposes. In a concluding note the properties of these systems are compared with those of the human eye. L. A. W.

920. Fatigue Effects in Cu_2O Photocells. W. Bulian. *Phys. Zeits.* 36. *pp.* 33–34, *Jan.* 1, 1935.—Cu_2O photocells under fairly strong illumination (quartz Hg-vapour lamp at 50 cm.) were found to fall off steadily in response until about 150 hr. continuous irradiation had occurred. It was found that this effect could be eliminated if the cell was enclosed in a vessel containing argon at one atmosphere pressure. A number of experiments designed to determine the reason for this are described. It is suggested that the effect is due to a chemical change of the Cu_2O layer immediately in contact with the Ag electrode. [See Abstract 5485 (1933).] D. H. F.

921. Transference of Electrons from Metals to Dielectrics. N. Kalabuchow. *Zeits. f. Physik*, 92. 1–2. *pp.* 143–146, *Nov.* 2, 1934.—The work of transference of electrons from silver to mica and rock-salt is measured approximately by observation of the current produced between a silver film on one side of a layer of the dielectric and a transparent electrode (saturated solution of NaCl) on the other side when the silver is illuminated through the dielectric by light previously filtered so as to have a known spectral composition. It is found that in each case the work of transference is less than the corresponding value for transference to vacuum (difference about 0·5 volt for mica and 1·8 volts for rock-salt). This is explained on the view that the energy of the electron need only be raised to the level of the conducting zone of the dielectric. The observed value for rock-salt is in agreement with that to be expected from the scheme of energy levels for this substance. [See Abstract 4405 (1934).] L. A. W.

See also Abstracts 682, 832, 885.

PIEZOELECTRICITY.

922. Reversibility of Piezoelectric Phenomena. P. Bernard. *Comptes Rendus*, 199. *pp.* 1388–1389, *Dec.* 10, 1934.—A quartz manometer, connected directly to the plates of a Dufour kathode-ray oscillograph, and intended for the measurement of gas pressures produced by combustion in closed vessels, was tested with an oil dynamometer. The results obtained for compressions and decompressions up to 289 kg./cm.^{2} on the quartz, taking place in time intervals of the order of 0·001 sec., show that the phenomena are reversible within the limit of repetition (1 %) of the observations. P. V.

***923. Method of Testing Crystals for Piezoelectricity. L. Bergmann.** *Phys. Zeits.* 36. *pp.* 31–32, *Jan.* 1, 1935.—The crystal is inserted between a horizontal metal plate and the base of a tuning fork held vertically, constant pressure being secured by a spring. The tuning fork and the metal plate are connected to an amplifier. The vibrations of the fork are transmitted through its base to the crystal, and the latter, if it be piezoelectric and correctly orientated, gives rise to an alternating p.d. which, after amplification, produces in the telephone a note at the tuning fork frequency. The electric axes are determined by rotating the crystal and observing the positions for maximum loudness. To test powders for piezoelectricity, a thin mica or glass plate is inserted between the powder and the base of the tuning fork. For quantitative work, a galvanometer is substituted for the telephone. P. V.

924. Temperature Coefficient of Quartz Oscillators. H. Straubel. *Zeits. f. techn. Physik*, 15. 12. *pp.* 607–608, 1934.—In a former paper it was shown that it is possible to reduce the temperature coefficient of frequency of thin discs of quartz to a very low value by properly selecting the orientations in which to cut them from the mother crystal [see Abstract 4755 (1934)]. Thin discs cut in other orientations usually have zero temperature coefficient at some temperature between − 100° C. and − 200° C., and in most cases the coefficient increases numerically with the temperature. P. V.

THERMIONICS.

925. Thermionic Emission and Activation of Gases at Hot Metallic Surfaces. B. S. Srikantan. *Indian Journ. Phys.* 9. *pp.* 161–166, *Nov.*, 1934.—A parallelism between thermionic emission and catalysis has been drawn. A view is advanced that in a hot metallic catalyst the process of activation is primarily due to the collision of the adsorbed molecule with the freely moving electrons; and an expression is derived, connecting the velocity constant and the temperature coefficient, which is tested by experimental data available. This is shown to be a more general equation than that of Arrhenius. AUTHOR.

926. Amplifying and Transmitting Valves Considered as a Problem in Electron Optics. M. Knoll. *Zeits. f. techn. Physik*, 15. 12. *pp.* 584–591, 1934.—Application of Watson's formula for the broadening of a parallel beam of electrons to the current-potential régime of amplifying and transmitting triodes shows that to a first approximation the electron paths are determined solely by the electrostatic electrode field. The electron paths determined in this way for an amplifying valve of the type REN 904 show that the curved boundaries found in each grid opening can be considered as electron lenses which divide the homogeneous electron current into a number of elementary rays. The errors of the elementary electron lenses lead to an effect analogous to the caustic curve of spherical lenses and to a corresponding current distribution in the grid-anode space. Application to the control grid of an a.c. potential alters the form of the elementary rays. At the same time a discontinuous anode current effect is superposed. This irregular current distribution can be made visible by the use of a material of low heat conductivity for the anode, as, *e.g.*, thin Mo wire. The electron-optic current distribution leads, for multiple-grid tubes, to a pronounced effect on the valve characteristic when the grids are so constructed that, viewed from the kathode, their openings cover one another. In this case a displacement of one grid relative to the other may give for a tetrode variations of as much as 1 : 10 in the screen-grid current and variations of the steepness of the characteristic of 1 : 2. A. W.

927. Independent Ionisation of Sodium and Cæsium Vapour on Glowing Tungsten and Rhenium Surfaces. H. Alterthum, K. Krebs and R. Rompe. *Zeits. f. Physik*, 92. 1–2. *pp.* 1–18, *Nov.* 2, 1934.—A wire heated electrically and raised to a potential of 200 or 300 V., is surrounded by a cylinder connected through milli- and micro-ammeters to the other end of the battery, and placed in a glass sphere inside an oven. The ionisation current is obtained for different values of the temperature of the wire and surroundings and it is found that with Re wire the percentage ionisation of Na and Cs is 20 and 25 % and with a W wire 8·5 and 45 %. The variation of ionisation with temperature for Na on W agrees well with Langmuir's theory, but Cs on Re and W are not in good agreement. The absolute value in all cases is found to be less than predicted by theory. Results are discussed. H. M. B.

928. Investigations with Kunsman's Anode. G. Gille. *Ann. d. Physik,* 21. 4. *pp.* 443–456, *Dec.,* 1934.—Experiments were made with Kunsman's anode, a glow electric source of positive alkali ions which is formed from a mixture of the oxides of Fe and Al and the alkali salt whose ions are to be obtained, and is remarkable for the constancy and strength of the ionic current emitted. The velocity of constantly accelerated Cs ions in dependence on the temperature of the source of the ions was measured between 650° and 1300° C. Constancy of the velocity was found from 650° to 900°, rise of about 0·5 volt from 900° to 1100°, constancy from 1100° to 1300°. The change of velocity is traced to a change of the glow electric egress work, and its possible connection with the β-γ transformation of the iron existing in the Kunsman's anode is discussed. The egress work of Cs ions was determined from saturation current measurements. There is a change of inclination of the Richardson lines at the β-γ transformation point of the iron, whereby the egress work from the γ modification at 3·15 volts is about twice as great as the egress work at 1·53 volts from the β phase. A modified form of the Kunsman's anode is described made of a small iron tube filled with alkali salt. There is not a satisfactory explanation of the change of the egress work, but the surface covering is thought to have a strong influence. J. J. S.

929. Experimental Determination of Electron Affinity of Iodine. P. P. Sutton and J. E. Mayer. *J. Chem. Phys.* 3. *pp.* 20–28, *Jan.,* 1935.—By observing the ratio of the negative ion emission to the electron emission from a thermionic surface of known temperature in an atmosphere of electronegative molecules of known pressure the electron affinity of the atoms can be calculated. A magnetron device has been used to distinguish electron and ion currents. With a tungsten filament at about 2000° K., and an iodine atmosphere of about 1 micron pressure, the electron affinity of iodine atoms has been found to be 72·4 ± 1·5 k. cal. AUTHORS.

930. Liberation of Electrons from a Molybdenum Surface by Positive Mercury Ions. S. D. Gvosdover. *Phys. Zeits. d. Sowjetunion,* 6. 3. *pp.* 415–423, 1934. *In German.*—An experiment is described in which it is found that mercury ions are only capable of freeing electrons from a molybdenum surface at about 1/6th the rate that they are freed by neon-ions, when the conditions are the same. The velocities of the ions of mercury vapour are for potentials of 0 to 500 V. This result is to be expected since the striking potential for mercury vapour requires a much higher voltage than is necessary for the inert gases. H. M. B.

931. Surface Migration of Adsorbed Atoms. A. Gehrts. *Zeits. f. techn. Physik,* 15. 11. *pp.* 456–461, 1934.—From a discussion of the results of numerous investigators the following conclusions are drawn: (1) The monatomic Th layer on Th-containing W and Mo wires arises from the migration of adsorbed Th atoms along the limiting surfaces of the grains. This applies both for the coatings produced by activation and also for such as persist after deactivation. (2) The proportionality between the activation constant and the reciprocal of the square of the radius of the grains in the wire surface, calculated on the basis of the above conclusion, is confirmed by the results of Fonda, Young and Walker. (3) The migration constant has a value of 5×10^{-11} cm.^{2}/sec. for a temperature of 2050° K. (4) The proportionality of $d\theta/dt$ (increase with time of the coating) with $1-\theta$ is based solely on the phenomena of migration of adsorbed Th atoms along the surfaces of the grains. In this connection it is necessary either to assume " induced " condensation or an increasing depolarisation of the Th dipole with increase of θ. (5) When the Th layer is produced by evaporation, the proportionality between $d\theta/dt$ and $1-\theta$ is based on the method of production of the Th layer; the coating does not increase proportionally with the time. (6) The calculation of the coating from saturation current measurements can be carried out for the case of activation by evaporation, for not too great values of the degree of coating, by use of the same relation (theoretically established by Schottky) as is used for the case of activation by surface migration. A. W.

932. Electron Diffraction on Oxide-Coated Filaments. H. Gaertner. *Phil. Mag.* 19. *pp.* 82–103, *Jan.*, 1935.—By a method making use of electron diffraction an examination was made of the surfaces of oxide-coated kathodes. The kathodes employed were formed from a paste, consisting of $BaCO_3$ and $SrCO_3$, painted on the flat base of a nickel block. The fresh layer gave a Debye-Scherrer diffraction pattern which was rather diffuse, but the activated layer gave much sharper rings with the structure of SrO, showing that in the activated state the percentage of SrO in the surface layers amounts to at least 90 %. If the heating process is interrupted before the activation is finished, some superfluous rings are to be found, which can be attributed partly to the carbonate structure of the initial state and partly to BaO. When the vacuum was not perfect sometimes a hexagonal structure appeared. This may possibly be due to some " poisoning " effect, as a connection was found with patterns taken from layers which were poisoned intentionally. A tetragonal structure found on two plates was attributed to hydroxide compounds, in agreement with the fact that the layers which showed this structure did not give any emission. A. W.

See also Abstracts 851, 888, 921.

THERMOELECTRICITY.

933. Thermoelectric E.M.F. Due to Magnetisation. T. Kousmine. *Helv. Phys. Acta,* 7. 7. *pp.* 732–772, 1934. *In French.*—The change in the thermoelectric e.m.f. of a couple comprising a ferromagnetic (iron or nickel) and an auxiliary metal (copper), due to the magnetisation of the ferromagnetic was measured with the magnetic field (*a*) parallel, (*b*) at right angles to the temperature gradient (junctions at 0° and 100° C.). For the parallel field the thermoelectric e.m.f. increased with field strength to a maximum at H = 110 gauss and subsequently decreased (Fe). A transverse field caused a decrease in the thermoelectric e.m.f. In both cases the maximum effect due to magnetisation was of the order of 1 % of the normal thermoelectric e.m.f. With a transverse field, the demagnetising action of the induced magnetisation modifies the effect. For nickel the results differ in the main from those for iron by showing no decrease in the effect at higher magnetic field strengths. The results are interpreted in the light of Perrier's theoretical work. W. S. S.

See also Abstract 893.